

# ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by

LEWIS STEPHEN PILCHER, M.D., LL.D.

of New York

With the Collaboration of

SIR WILLIAM MACEWEN, M.D., LL.D.

of Glasgow

W. H. CLAYTON GREENE, F.R.C.S.

of London

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No. 1

## NEW MECHANICAL PROBLEMS IN THE BRONCHOSCOPIC EXTRACTION OF FOREIGN BODIES FROM THE LUNGS AND ŒSOPHAGUS

BY CHEVALIER JACKSON, M.D.  
OF PHILADELPHIA, PA.

IN the early days of bronchoscopy and œsophagoscopy no thought was given to the matter or the mechanical problems of the disentanglement, disimpaction or version of foreign bodies. The whole art of endoscopy was thought to consist of introduction of the instruments. This was considered a formidable task. One text-book stated in effect that if the bronchoscope could not be introduced through the mouth in fifteen minutes a tracheotomy should be done for the introduction of the bronchoscope through the neck. To-day, anyone who has been taught a proper technic, and who has instruments proper for the particular patient, should insert the bronchoscope in less than a minute. In the early days referred to, when the foreign body was seen, forceps were introduced, the foreign body was seized often along with tissues, and the foreign body was ruthlessly torn out at all hazards. In 1914 the author<sup>1</sup> called attention to the necessity of a careful study of the mechanical problems of foreign body disentanglement and removal and illustrated the general mechanical principles he had applied to the extraction of a large variety of foreign bodies. These were added to in subsequent publications<sup>2</sup> and<sup>3</sup>. Since then there have come to the Bronchoscopic Clinic so many different varieties of foreign bodies that now, with a total experience of 891 foreign bodies in the air and food passages, I am able to present additional data that will, I venture to think, place the matter on a scientific basis. By this I mean only a basis; future developments doubtless will make present attainments appear embryonic. It will, however, always hereafter be regarded as fundamental that: (1) A foreign body usually presents a mechanical problem of disengagement, disentanglement, version, method and location of seizure, etc., which must be worked out if low mortality and close to 100 per cent. of successes is to be attained; and (2) conversely, grasping the first part of the foreign body seen and ruthlessly tearing it out is brutal and conscienceless, and will inevitably give a low percentage of successes and a high mortality ratio.

*Handwritten:*  
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*Movements of the Bronchi.*—In dealing with the problems of foreign-body extraction due consideration must be given to the bronchial movements, not only because of their increasing the difficulties in certain instances, but even more because of the invaluable aid they render to the bronchoscopist who waits and watches for the advantageous phases of their movements, as herein mentioned in connection with forceps spaces. The shortening during cough is also of advantage in protruding slender bodies that are completely within small branch bronchi, too small to enter, as first pointed out by the author.<sup>2</sup>

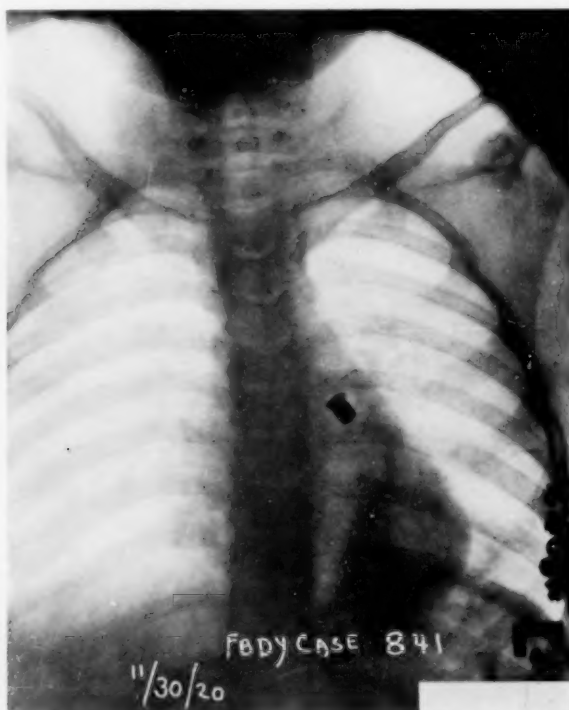


FIG. 1.—Cartilage primer in left bronchus of a boy aged 7 years. The mucosa had swollen proximally until it presented the problem the solution of which is illustrated in Fig. 2. Plate made by Dr. Willis F. Manges.

The movements of the tracheobronchial tree, as I have observed them bronchoscopically, may be categorically enumerated as follows:

1. Expansion during inspiration.
2. Collapsing during expiration, almost all of the collapsing excursion being at the beginning of the expiratory phase.
3. Elongation during inspiration.
4. Shortening during expiration.

## BRONCHOSCOPIC EXTRACTION OF FOREIGN BODIES

5. Excessive contraction in one, many or all diameters during cough. Sometimes in children this bechic contraction is sufficient to obliterate the bronchial lumen. In the trachea of children the posterior (membranous) wall is at times projected forward convexly into the tracheal lumen.

6. Excessive shortening during cough.

7. Displacive movements in various directions, but chiefly sidewise, caused by the movements of adjacent viscera, chiefly the heart and great vessels, but in some instances by the opposite lung.

It must be remembered, that, though here listed separately for clearness, two or more of the bronchial movements are often combined, as elsewhere mentioned.<sup>2</sup>

*Education of the Eye and the Fingers.*—Nothing will take the place of work with the eye at the tube. The gauging of depth comes only slowly by dint

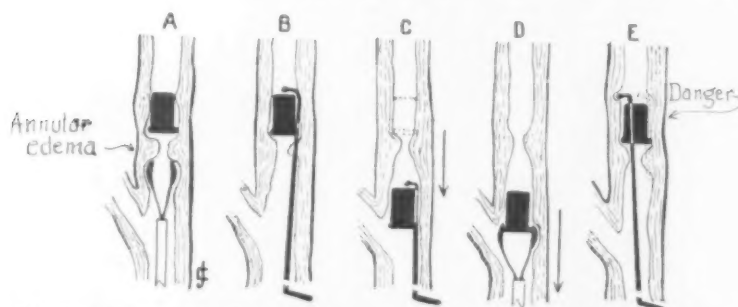


FIG. 2.—How a special probe-ended hook was used to withdraw the primer cap shown in Fig. 1 to a higher, hence wider, location in the bronchus, so forceps could be applied. Removal required 18 minutes and 33 seconds (Case No. Fdby. 841). At A is shown the impossibility of applying forceps because of the proximal annular edema. At B the hook has been insinuated past the cap. C, the cap withdrawn above the edematous area to a widening of the bronchus where a lateral branch is given off. In this location it was easy to apply the forceps securely for the withdrawal (D). In using hooks it is necessary to be exceedingly careful to avoid pulling when the hook slips around to the wrong side (E). Pulling then might cause fatal trauma. No hook of more than a half turn (90 degrees) should be used because of the risk of getting caught in a bronchial orifice. Usually they are better made spirally.

of long practice. Manipulations to be safe must be guided by the eye, and it must be a trained eye. Coördinate manipulations of the tube and forceps must be practiced until work is as natural and familiar as with knife and fork. It is as impossible as it would be brutal to attempt to acquire this coördinate skill by practice on the living human being. Appalling mortality and failure to acquire the skill would result. Fortunately the simple rubber-tube manikin<sup>3</sup> serves the purpose perfectly, as it is always available for practice in spare moments. Next should come practice on the cadaver and on the living dog with foreign bodies of various kinds placed in the bronchi. One is never through practicing for the general education of the eye and fingers. In addition to general practice with miscellaneous objects, when a foreign body case comes in, the endoscopist should place a duplicate of the foreign body in a rubber tube of the size of the invaded bronchus, and by manipulation with bronchoscope, or œsophagoscope, as the case may be, he can familiarize himself with the appearances of the foreign body in every

possible presentation and he can study and work out a solution for every possible problem. A little ingenuity will closely simulate every difficulty to be encountered in the living patient. For instance, little useful practice will be afforded by removing peanut kernels loosely rattling round in a rubber tube of large diameter. Peanut kernels are not encountered that way in the living human bronchus; they are tightly bedded in the smallest bronchi they can enter. For simulating actual working conditions a half kernel should be pushed down into a rubber tube in which it is a tight fit. Then let the practitioner practice the removal as mentioned under "Peanut Kernels." If anyone will follow this plan he will come close to 100 per cent. successful

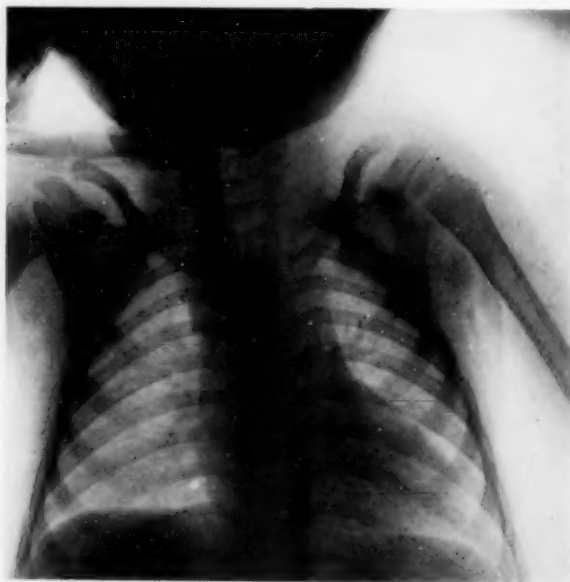


FIG. 3.—This coin is apparently just ready to be easily picked out with any kind of forceps. As a matter of fact a very good endoscopist, after an hour's work under ether, failed to grasp the coin for the lack of appreciation of the very simple mechanical principle illustrated in Figs. 4 and 5. Similar cases are constantly coming to the Bronchoscopic Clinic. Plate by Dr. Willis F. Manges.

removals and will have little or no mortality. I am sure that the appalling mortality that has attended bronchoscopy and œsophagoscopy in inexperienced hands would never have occurred had the operators realized how little chance there is of the survival of a little child undergoing an œsophagoscopy in inexperienced hands. This is true of simply the introduction of the œsophagoscope. How much more forcibly it should apply to complicated removals. For instance, no one should think of attempting the endoscopic removal of a safety-pin without hundreds of hours of training of the eyes and fingers to the unusual requirements of the work. To ignore this is to trifle with human life. It is infinitely worse than to attempt removal of cataracts from a living human eye without previous practice on dead animals'



## BRONCHOSCOPIC EXTRACTION OF FOREIGN BODIES

eyes, which would result in blindness, not death. The removal of an open safety-pin is infinitely more difficult to learn because the cataract operation is a bimanual and binocular procedure to which all surgical work is more or less a fundamental training; whereas foreign-body endoscopy is a monocular, depth-gauging procedure surrounded by so many limitations and difficulties as to place the operator under "an indescribable stress" as Ingals so aptly stated. For a surgeon to telegraph for a bronchoscope or an œsophagoscope the like of which he never saw before and to start down the tender passages of a child in search of an open safety-pin usually ends in involuntary manslaughter, using the term literally, not in its technical sense. The author assumes part of the responsibility for these not infrequent deaths. From a mistaken sense of modesty he refrained from stating the case strongly so long as few or none had equal opportunities for experience;

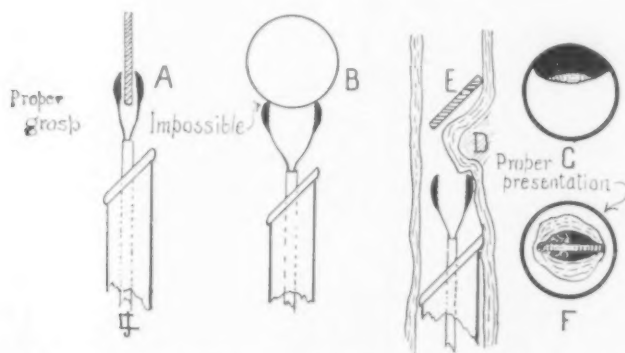


FIG. 4.—The cause of many failures to seize a coin in the œsophagus. The seizure should be flatwise as at A, not edgewise as at B. No attempt should be made to seize the coin in the position in which it is usually first seen, C, because one jaw of the forceps will strike the cricopharyngeal fold, as shown in cross-section at D, preventing the jaws from advancing far enough toward the coin to grasp it properly. The lip of the œsophagoscopic tube-mouth should be used to obtain a proper presentation as shown at F. The same principles govern the grasping of all flat objects in the œsophagus or tracheobronchial tree.

but now that every large medical centre has an experienced endoscopist, there is no more need of totally unexperienced men attempting œsophagoscopy than for every internist to do his own appendectomies.

*The study of the presentation* is fundamental for safety and success. In foreign-body bronchoscopy, as in accouchement, the ruthless pulling upon any part presenting without consideration of the other parts is to court disaster. Just as the obstetrician studies out the position of the fœtus and every part of its anatomy in relation to the maternal pelvis just so must the endoscopist study the position of the foreign body and the relation of its every part to the invaded bronchus or œsophagus. Just as the obstetrician depends upon abdominal palpation to aid him in his interpretation of the presentation, so the endoscopist studies the röntgenogram made in two planes, the lateral and the anteroposterior, so that he may know, when he looks at the endoscopically visible part of the foreign body, where the other parts lie. The ray-plates should be on a shadow-box in the operating room; and the

author prefers to have the plates placed upside down for a better conception of the relations in the recumbent patient. When the presentation is not a favorable and safe one for delivery, a version must be done, as, for instance, when the pointed limbs of a double-pointed tack<sup>2</sup> are turned away and the head brought into the presenting position—a cephalic version.<sup>4</sup>

*Forceps Spaces.*—Fundamental in the endoscopic removal of foreign bodies is the matter of forceps spaces, which is the name I have given to the spaces between the foreign body and the wall of the invaded bronchus or œsophagus and into which the jaws of the forceps must go before they can grasp the foreign body. Of all the causes of failure to remove a foreign body whose location has been reached, in the cases coming to the Bronchoscopic Clinic, none is so frequently the evident cause of failure as lack of

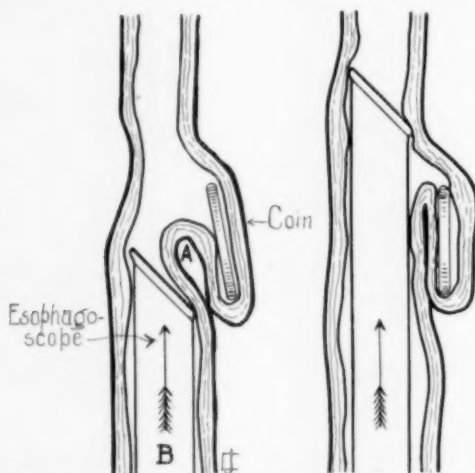


FIG. 5.—How a foreign body is so frequently overridden unseen by the inexperienced œsophagoscopist. The œsophagoscope advancing in the direction of the dart through the normally collapsed œsophagus, pushes ahead of the tube-mouth a fold, A, that obscures the view of the coin, which becomes buried in the folds alongside the advancing œsophagoscope. This is most likely to occur at the cricopharyngeus, but may occur at a number of other locations.

knowledge or appreciation of the fundamental importance of forceps spaces. Over and over again the mucosa in the neighborhood of a foreign body has evidently been traumatized in an effort to force the jaws over the foreign body when no spaces for the entrance of the jaws existed, or futilely jamming the forceps into the mucosa in an effort to force the forceps onto a foreign body with the jaws opening sagittally ignoring the lateral forceps spaces that would have facilitated grasping had the forceps been turned so the jaws would open in the coronal plane. Had the bronchoscopist been working with both eyes and both hands in an open wound, he would make no such mistake but being unfamiliar with the work and never having been taught the necessity of study of the forceps spaces, when he at last finds a foreign body for which he has been searching he thinks of nothing in his haste to use the

## BRONCHOSCOPIC EXTRACTION OF FOREIGN BODIES

forceps. Many blind graspings and jabbings in the neighborhood of the foreign body not only fail to grasp it, but by the blood drawn from the mucosal vessels the intruder is so obscured that recognition afterward becomes impossible, and the foreign body is "lost." Had the bronchoscopist recognized his forceps spaces, or created one or two as the case required, the forceps could have been accurately placed under the guidance of the eye and removal accomplished in a few seconds or minutes at the first attempt. Forceps spaces are usually at their maximum on inspiration. They decrease immediately, not gradually, at the beginning of the expiratory phase of the respiratory cycle.

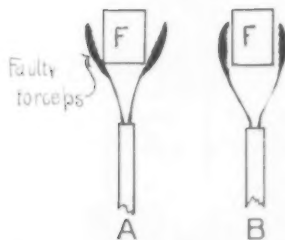


FIG. 6.—Good and bad construction of forceps. The faultily constructed forceps (A) with planes of grasping surfaces divergent, not only afford an insecure grasp, but, by reason of the small area of contact, really only pivotal, permit the foreign body (F) to swing sidewise at every touch of the natural passages, which swinging is sure to result in loosening the foreign body from the grasp of the forceps. Proper forceps (B) have the planes of the grasping surfaces parallel.

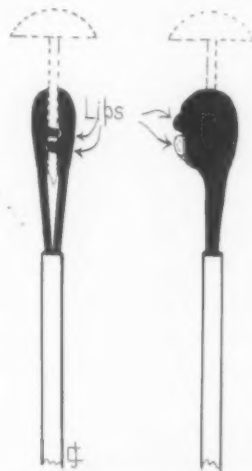


FIG. 7.—Side and top views of the Tucker forceps. The small lips added to one side of the side-curved forceps by Dr. Gabriel Tucker prevent the slipping out of the shaft of a foreign body, such as a tack or a pin, or a safety-pin, during the turning out of the point from the mucosa and the bringing of the point into the tube-mouth. This forceps adds to the Jackson method of safety-pin removal a certainty which makes this method an ideal one. The Tucker forceps are also excellent for the disimpaction and removal of tacks, pins and nails.

In some cases both spaces exist only on inspiration, and the bronchoscopist must wait and watch, with forceps jaws close to the foreign body, for his opportunity, early in the inspiratory phase of the respiratory cycle, promptly, though gently, to insert the forceps jaws into the forceps spaces as they gape. The prompt collapse of the bronchial walls at the beginning of inspiration renders it necessary to start the insertion of the forceps jaws at the beginning of the inspiratory phase. If later, the jaws will be met and stopped by the collapsing walls. Where one space only exists, and that on inspiration, one of the hereinafter mentioned means must be used to get the



foreign body into a new position in which two forceps spaces will appear either continuously or on inspiration. This respiratory opening and closing

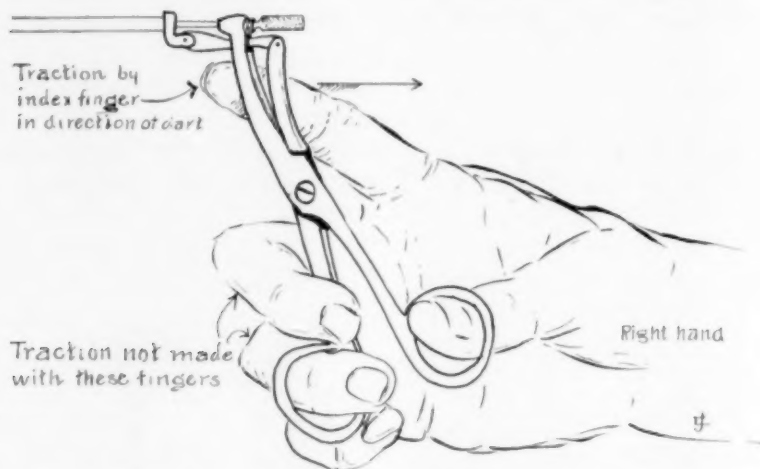


FIG. 8.—Proper manner of holding forceps. The ring-finger in the ring; the index for pulsion and traction.

of the forceps spaces is most frequently seen in cases of peanut kernels in the bronchi, in which class of cases the forceps spaces admit air ( See colored

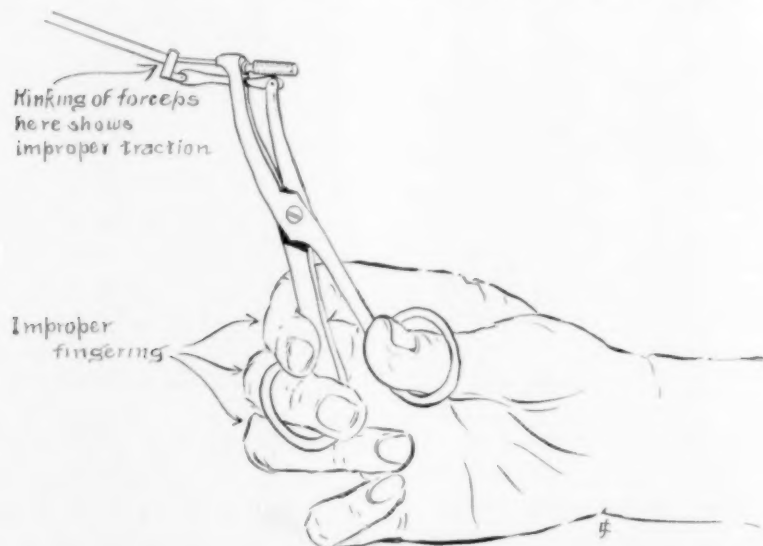


FIG. 9.—Improper use of forceps. Forceps can be so constructed as to do away with the springing upward here shown; but the delicacy of touch essential to safe and efficient work would be thus destroyed.

plate). Where forceps spaces do not exist they may be created by four different means, used singly or in combination of one or more, involving more or less change in the presentation.

## BRONCHOSCOPIC EXTRACTION OF FOREIGN BODIES

1. Displacement of one wall with the lip of the bronchoscope or œsophagoscope.
2. Tilting of the foreign body with the lip of the bronchoscope.
3. Tilting of the foreign body by means of the side-curved forceps insinuated at one side and used as a hook.
4. Withdrawal of the foreign body by means of hooks of certain permissible forms, to a new position in which less swollen walls or a normally larger lumen creates forceps spaces. If withdrawal to the site of a branch bronchial orifice can be accomplished, large forceps spaces are afforded (Fig. 2).

Of all causes of failure of our predecessors to remove a coin in the œsophagus in the cases coming to the Bronchoscopic Clinic, next to failure

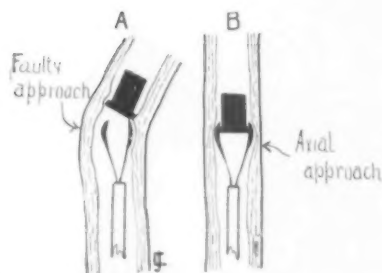


FIG. 10.—If the axis of approach is at an angle (A) instead of vertical to the presenting plane (B) of the foreign body, the intruder will be pushed down without either blade having had any chance to pass outside of the presenting part of the foreign body. The faulty angle of the approach (A) will often be encountered unless the head of the patient is moved in the proper direction to obtain an axial presentation of the bronchial lumen and an axial approach (B) to the foreign body.

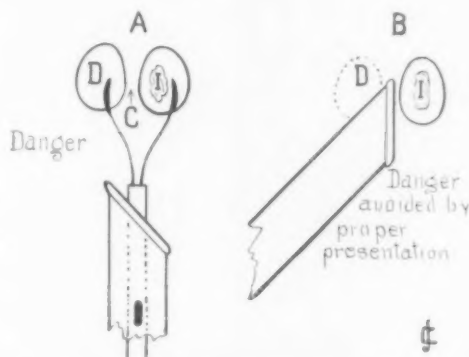


FIG. 11.—How to avoid including the dividing spur in the grasp of the forceps. If in an attempt to grasp the foreign body, I, the forceps are allowed to expand with the bronchoscope exposing both bronchial orifices as at A, the spur is apt to be caught, giving an insecure hold, and dangerous trauma is almost certain to be inflicted. (See illustration D in the colored plate). By moving the head to the left the foreign body is presented centrally and the spur, C, is out of the way to the left, the bronchial orifice, D, passing out of the endoscopic field of vision and out of harms' way.

to find the coin because of overriding, the most frequent cause has been failure to establish two forceps spaces that would permit of proper approach and proper grasping, as shown in Fig. 10. It seems strange that a man who would naturally pick up a flat object flatwise if he were working at a bench with nippers, will try to put on the forceps edgewise in his haste to grasp a coin for which he has been, perhaps, searching a long time; yet the forceps marks on the mucosa and the statement of the unsuccessful œsophagoscopist showed clearly in dozens of these cases the faults mentioned.

**Forceps.**—Endoscopic foreign-body work differs from general surgery in that instruments must be properly constructed to obtain a high percentage of successes and a low mortality. The abdominal surgeon may use a kitchen spoon as a makeshift retractor without loss of time or efficiency; but the limitations inseparable from the necessity of working through a long endoscopic tube of small diameter are such that the slightest departure from the required design may make all the difference between success and failure,

indeed between life and death. For instance, the slight departure from the shape of the jaws of the forceps shown in Fig. 6 made the forceps worthless. The endoscopist who failed to hold his foreign body did not realize that though they had been foisted upon him as of my design they were faulty copies of the forceps that have stood my every test for twenty years. When properly made they convey an exquisitely delicate sense of touch. For general purposes the side-curved forceps advocated by me in the early days of bronchoscopy still remain the standby for the majority of the cases, with the plain forceps and the rotation forceps next in usefulness. On rare occasions

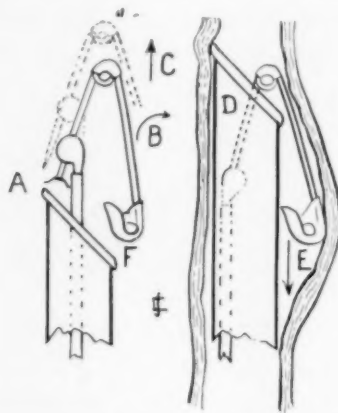


FIG. 12.—Author's method of dealing with the problem of the safety-pin lodged open and point upward. The point of the pin is always sunken into the mucosa as shown at A. The pointed branch of the pin is seized with the forceps, which are then rotated about 90 degrees, so as to get under and turn out the point as the pin is pushed downward with the forceps. This double movement is indicated by the darts B and C. The tube is then pushed downward over the pointed branch of the pin until this branch is completely within the tube (D). The pin is then withdrawn, the keeper sliding harmlessly up outside the tube (E). The keeper really lies closer than shown in the drawing which is made schematically to emphasize the fact that the keeper is outside. Care to maintain the greater plane of the keeper coronally is necessary at the cricoid in the case of the œsophagus, or sagittally at the glottis in case of the tracheobronchial tree.

it has been found advantageous to lock the forceps closed on a foreign body while at work upon it. For this a clamp is applied to the handle.

A number of special forceps for special purposes have been devised. Of my own devices there is no need of mention here. Spencer's forceps hold screws well.

My assistant, Doctor Tucker, has added a lip to the side-curved forceps which overcomes one of the greatest difficulties in turning out the point of pins, safety-pins, needles, tacks and similar objects when the point is buried in the mucosa. The lip is too short to inflict serious trauma from light grasping. Of course, if traction is made upon tissues serious or fatal trauma may be inflicted with any kind of forceps. Care and gentleness are necessary in the use of any kind of bronchoscopic or œsophagosopic instruments.

As mentioned under "Use of Forceps," heavy construction destroys all delicacy of touch. Great strength is not necessary; but the temper of the steel must be such that it will bend before it will break. Occasionally it may



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be desired in the solution of some mechanical problem to clamp the forceps onto a foreign body in a certain chosen position. For this purpose the clamp shown is used. It is so rarely required that it is made detachable and applicable to any of the forceps handles.

*The use of forceps* requires study and, especially, practice, so that their handling and coördination with the tubal manipulations becomes as natural



FIG. 13.—This illustration shows the advantage of turning the röntgenogram upside down for oesophagoscopy and bronchoscopy in the recumbent position. This contributes to a proper conception at bronchoscopy of where the unseen parts of a foreign body are in relation to the visible parts. The irregular, double, hook-shaped piece of metal was in the oesophagus of a girl aged three years. (Case No. Fbdy. 785). Both hook-shaped ends were buried in the oesophageal wall requiring special manipulations for the solution of disentanglement and safe removal. By comparing the schema, Fig. 14, it is seen that by placing the röntgenogram upside down all the relations correspond to those encountered at endoscopy.

and automatic as the use of knife and fork. The forceps are, mechanically speaking, a prolongation of the fingers. Their necessarily great length makes their use somewhat in the nature of walking on stilts. Special practice is necessary to acquire perfect control. This practice should be first on the rubber tube manikin and this practice should never be abandoned. It is what scales and exercises are to the musician.

The forceps should be held as in Fig. 8. This placing of the fingers can be memorized by the formula: "The ring finger in the ring." This position leaves the index finger free for pushing (always gently) on the stylet. When traction is necessary it is also made with the index finger in a mechanically correct manner, as shown in Fig. 9. It is for this use of the index finger that this forceps was designed. It gives a delicacy of touch transmitted through the most sensitive tactile member with which man is

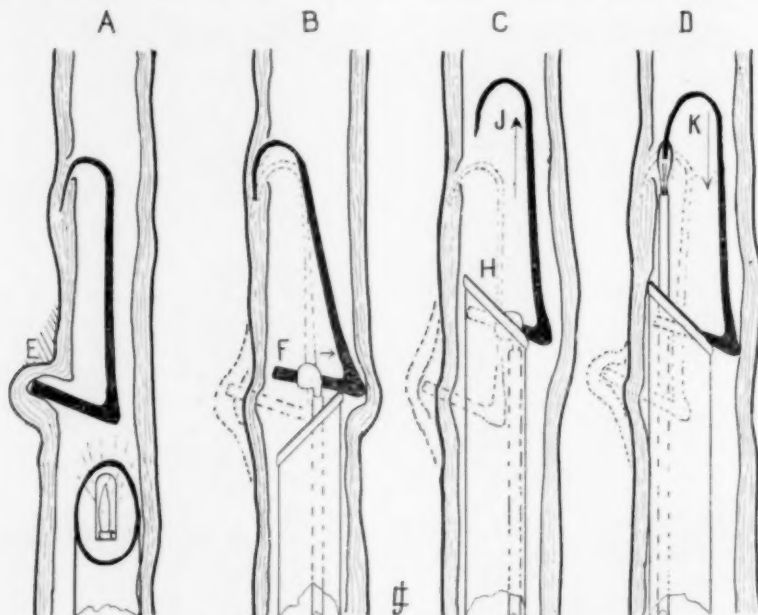


FIG. 14—Schematic illustration of the problem of the double opposed hooks presented in the case illustrated in Fig. 13. The distal hook had penetrated the mucosa, while the proximal hook, E, was buried and locked in a fold above the cricopharyngeus (E) over which it was hooked. The removal was accomplished in six stages:

- 1—Manipulation of the proximal hook strongly in the direction of the dart, F.
  - 2—Guiding the proximal hook down through the cricopharyngeal narrowing, E, so as to disengage the distal hook, J.
  - 3—Pushing the œsophagoscope downward so as to repress the cricopharyngeal fold, E.
  - 4—Placing the lip of the tube-mouth under the proximal hook, H, to prevent its catching during withdrawal.
  - 5—Seizing the point of the distal hook, K, with forceps to prevent the point catching during withdrawal.
  - 6—Withdrawal of the foreign body, the forceps and œsophagoscope together as one piece.
- Time required: 9 minutes and 37 seconds. No anæsthesia was used and there was no trauma and no reaction. (Case No. Fbdy. 785.)

endowed. Forceps designed to do away with the springing upward, shown in Fig. 9, are like making a violin bow of cast iron so it will not yield. The parts of a forceps outside the tube can be made as heavy as desired and opening springs may be added; but when these things are done all delicacy of touch is destroyed.

*The axis of approach of forceps* is of the utmost importance, and especially so in case of foreign bodies with a more or less flat face occluding most of the area of cross-section of the bronchus. As will be understood from Fig. 10, a wrong angle of approach may make all the difference between the removal in a few minutes on the one hand, and on the other, not only

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failure to seize the foreign body but pushing it down tightly into a position in the bronchus from which removal may be exceedingly difficult. Before insertion of the forceps the axis of the bronchoscope should always be brought into the position in which its axis corresponds to that of the invaded bronchus. If in doing this one edge of the field of view is obscured by the projection of the angle of the bronchial wall, the obtruding angle may be repressed with the lip of the bronchoscope. Usually all that is required is the rotation of the bronchoscope so as to bring the lip around to the obtruding sector. In the œsophagus axis of approach may increase those difficulties of proper grasp due to faulty presentation and lack of forceps spaces, as illustrated in Fig. 4.

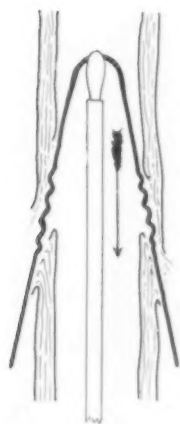


FIG. 15.—Schema showing how fatal trauma can be and has been inflicted by injudicious traction, in the direction of the dart, on a hair-pin lodged points upward in the œsophagus.

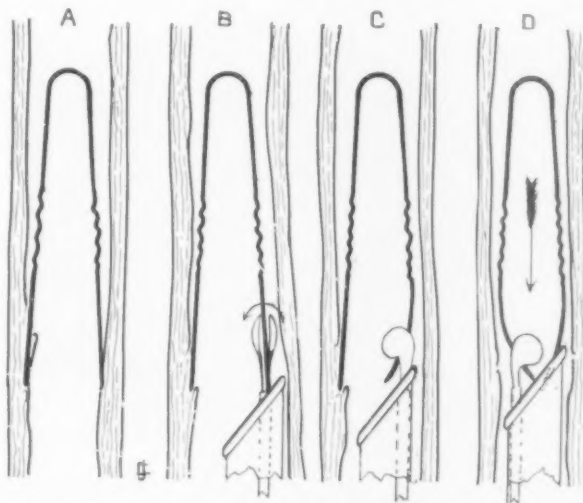


FIG. 16.—Schema showing how the danger shown in Fig. 15 was avoided by a carefully worked out solution of the mechanical problems involved. The points of an object like this have either penetrated the mucosa or penetration is imminent. First one point is turned with side-curved forceps (B, C); then the œsophagoscope (or bronchoscope) is pushed down so that the turned point rests on the lips of the tube-mouth while the other point is turned in. Thus protected, traction in the direction of the dart is safe. (Case No. Fbody. 837).

*Avoidance of inclusion of tissue* in the grasp of the forceps is very important for three reasons: (1) Serious or fatal trauma may be inflicted by the laceration of blood-vessels. (2) Laceration of the bronchial wall may allow air and infective material to leak into the pleural cavity, producing a serious complication, or into the mediastinum, causing death. (3) Tissue between the forceps and the foreign body renders the grasp insecure. For these three reasons pulling upon a foreign body when tissue is included with the foreign body in the grasp of the forceps usually ends not only in failure to remove the intruder, but also in serious or fatal illness of the patient. See Fig. 11; also D in the color plate.

*Safety-pins.*—An open safety-pin, lodged point upward in the hypopharynx, is readily rotated with alligator forceps so that the point is in the

spatular tip of the laryngoscope which thus protects the tissues from laceration. The same method is ideal also in cases of laryngeally lodged safety-pins. In cases of deeper lodgment in either the œsophagus or tracheobronchial tree the pin may be similarly removed by flipping the point onto the lip of the tube-mouth or the pin may be closed or removed by the author's point-protected method<sup>2</sup> by which the pointed branch of the pin is brought as far as it will come into the tube-mouth. The pin, forceps and tube are then all brought out together, the keeper branch sliding upward harmlessly on the outside of the tube. Fig. 12 illustrates the method more clearly than the original illustration. This method will be greatly facilitated by the lips added to the side-curved forceps (Fig. 7). The chief difficulty encountered in the plan of

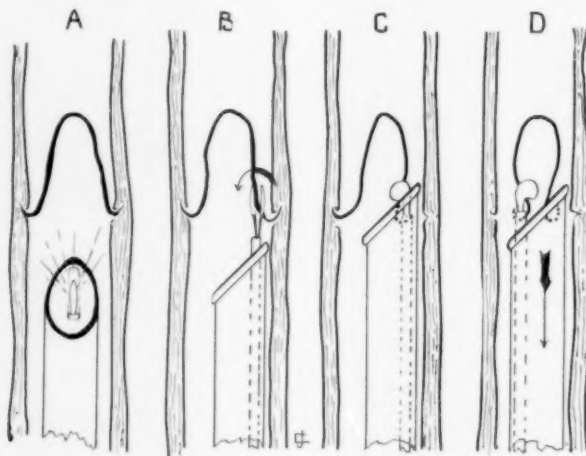


FIG. 17.—Schematic illustration of the method of disentangling a sharp-pointed, double, hook-shaped wire from an egg-beater that had lodged in the œsophagus of a woman aged 57 years, while eating custard pie. (Case No. Pbdy. 434.) The two hook-shaped sharp ends were buried in the mucosa (A). At B and C are shown the author's "outward rotation method" of disembedding buried points of any kind; in this case the wire being annealed the points were easily bent, one at a time, inward toward each other to get them into the tube-mouth for safe traction (D). The solution of the problem would be the same if the foreign body had lodged with the hooked ends downward. The method used in this early case has since been used many times in the Bronchoscopic Clinic for the removal of hair-pins, bent wire, etc.

getting the pointed branch into the tube-mouth was the tendency of the spring of the safety-pin to throw the pointed branch out of the grasp of the forceps. This the lips of Tucker's forceps prevent. These forceps make of my point-protected method the least difficult of all the plans of dealing with the open safety-pin. Closure and endogastric version are two excellent methods elsewhere described. Success and a reasonable degree of safety with any method of extraction of safety-pins lodged point-upward requires long preliminary practice on the rubber tube.

*Rules for Röntgenographic Examination of Safety-pin Cases.*—In dealing endoscopically with an open safety-pin, lodged point upward, the six most essential things to know beforehand are:

1. The size of the pin.



Endoscopic views illustrating mechanical problems encountered in cases of foreign bodies in the lungs. A. Foreign body (a bone) impacted in a bronchus so tightly that no forceps-spaces existed. Before admission prolonged fruitless efforts under general anaesthesia had been made to grasp the foreign body without realization of the impossibility of doing so in the absence of forceps-spaces. The inflammatory areola shows where the mucosa had been punched with the opened forceps. B. Same patient as in A after I had created lateral forceps-spaces by withdrawing the foreign body to a higher level with a hook. Forceps were then readily applied and the foreign body was easily removed. C. Mucosal trauma inflicted by the attempt to force forceps jaws onto a foreign body sagittally where no forceps-spaces existed, ignoring good lateral forceps-spaces. D. The trauma, indicated by the inflammation, the swollen dividing spur and the patch of exudate on the mucosa of the left-hand orifice, was inflicted before admission by the faulty attempt to grasp the foreign body seen in the right hand orifice. The inclusion of the dividing-spur is easily avoided by the method shown in the schematic illustration, Fig. 11. My predecessor in the case stated that he had grasped the foreign body and had pulled as hard as he dared. As the foreign body was free to move it is certain the traction was being made upon forceps that included tissue as well as foreign body. E. Endoscopic view in the lower-lobe bronchus showing a tack that, before admission, had been injudiciously pulled upon without first disengaging the point. Release of the point by the author's outward rotation method after pushing the tack downward resulted in a prompt and safe removal. F. Annular edematous (not fibrous) stenosis from the trauma inflicted before admission, in jamming the foreign body (a screw) down in a bronchus, in a faulty effort to grasp the screw-head in the absence of forceps-spaces. On admission only a tiny portion of the screw-head was visible and the situation of the slot or filister indicated a slight tilting of the screw. The problem in this case was solved by withdrawing the screw to a new position above the edematous area with the closed side-curved forceps used as a hook. The same forceps were then used in the usual way to grasp and remove the foreign body. G. A peanut kernel in the bronchus of a child. During expiration, as here shown, no forceps-spaces existed because of the collapse of the bronchial walls during this phase of the respiratory cycle. H. Immediately upon the beginning of inspiration the bronchial walls recede from the peanut kernel, creating large forceps-spaces between it and the bronchial walls. In the case here illustrated the spaces are located anteriorly and posteriorly. It is early during this inspiratory stage of respiration that the forceps must be placed. The here-shown phenomenon of the opening and closing of the forceps-spaces in respiration is the mechanism by which air is trapped in the invaded lung or lobe, producing the obstructive emphysema that is diagnostic of the presence of a peanut kernel in the lung. In this case Dr. Willis F. Manges had made a diagnosis of non-opaque foreign body, probably peanut kernel, in the right bronchus, in the absence of a history.





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1. The size of the pin.
2. The greatest spread from the point to the keeper.
3. The exact plane of this greatest spread.
4. The direction of the point.
5. The precise location of the point, the keeper and the spring.
6. The degree to which each of the two branches of the pin deviates from the vertical axis of the patient's thorax.

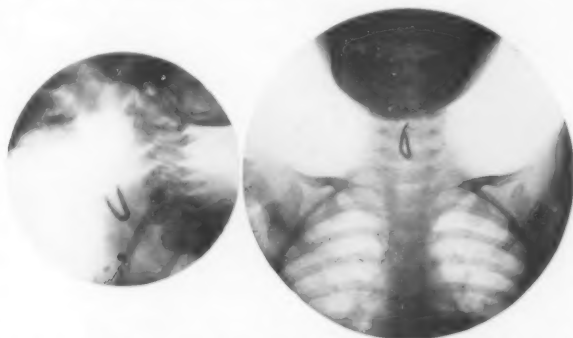


FIG. 18.—Röntgenograms, anteroposterior and lateral, showing staple in the subglottic trachea of a girl, aged 4 years (Case No. Fbdy. 825). Removed laryngoscopically through the mouth by cephalic version, in one minute and thirty-five seconds, without anæsthesia, general or local. The illustration also shows the necessity of the ray study in two planes. The lateral view conveys no idea of the complicating curves and divergent points that it was necessary to know in order to accomplish the version. Plates made by Dr. Willis F. Manges.

7. Bends, breaks, kinks or other imperfections of the pin.

More failures safely to remove safety-pins have resulted from lack of a properly preconceived mental conception of all of these data as to the particular case than from any other one cause. All of these data can be supplied

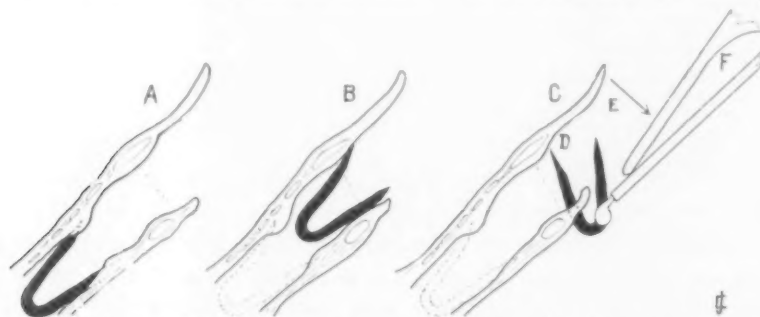


FIG. 19.—Illustrating the solution of the problem of the staple, with buried points, in the case illustrated in Fig. 18, by posterior version (C). The turning was done after working the staple upward, one point at a time (B), always guarding the advancing point. The trailing point (D) has no tendency to puncture. The laryngoscope (F) is exerting pressure (E) on the forceps in a posterior direction to complete the version.

by the röntgenologist. To get these data one plate at least should be free from foreshortening. With these data and a duplicate of the pin the trained bronchoscopist can in a few hours with his bronchoscope or œsophagoscope and a bit of rubber tubing work out the problem in such a way as to make him feel sure of safety and success in dealing later with the patient. The

working plates in the operating room should include a lateral, an antero-posterior and one free from foreshortening.

*Irregular Metallic Objects.*—The varieties of these are numerous; but the general principles of the solution of the problems of extraction are the same. A careful ray-study in all planes is made to ascertain the dimensions of the foreign body and the planes in which the greatest and least dimensions lie. Then a study is made to determine the position of points, rough places, hooks, angles or any other potentially traumatizing characters of the foreign body. A plan is next worked out, first in theory, then on the rubber-tube

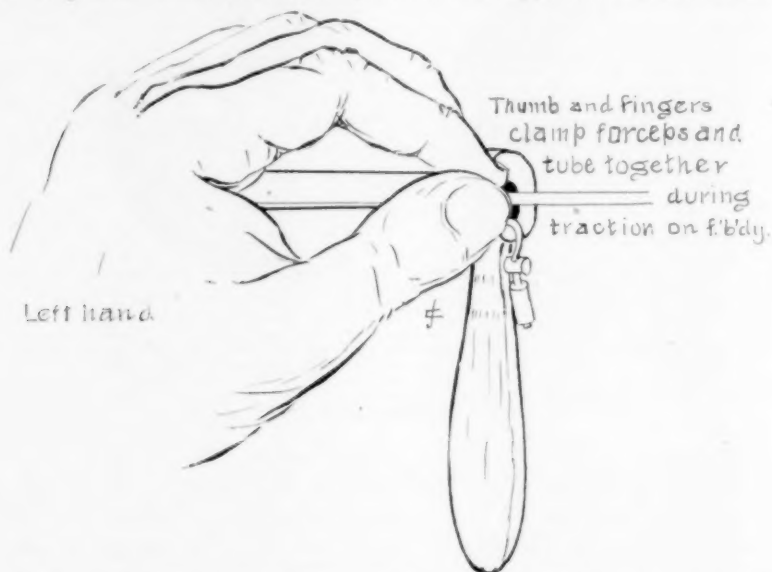


FIG. 20.—In order to avoid the lagging behind of the foreign body (see Fig. 21) and to insure the movement together of the foreign body, the forceps and the bronchoscope, all as one piece, the left hand should be used as here shown to clamp the cannula of the forceps against the proximal tube-mouth while traction is being made. The left hand should make all the traction, the right hand simply moving along passively while making the necessary degree of compression on the forceps handles. This method applies to the removal of any and all foreign bodies that are too large to be withdrawn through the tube.

manikin, by which hooks are disengaged, points guarded, rough places turned or held away during withdrawal so as to avoid trauma. A good illustration of the method of working out these various problems, or combinations of problems, is shown in Figs. 13 and 14, and will be understood from reading the legends.

*Hair-pins and Bent Wires.*—These cases are similar to the staple in that the points become buried (Fig. 15 and Fig. 17), but they differ in that the wire is of smaller gauge and is annealed, hence is easily bent. The fence staples are of rigid wire that cannot be bent or cut by any instrument that can be used through a bronchoscope.

The wire from an egg-beater was quickly and safely removed by the method shown in Fig. 17.

The hair-pins were removed by the method illustrated in Fig. 16. Being

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of stiffer wire a forceps of different shape facilitated the bending of the points.

*Fence Staples.*—The surpassing difficulty in dealing endoscopically with these objects when encountered points upward, as they usually are, arises from their construction. In order to be driven into wood the points are made very sharp and the steel is very rigid. The points are spread and they rip in upon the slightest effort at traction. The wire cannot be cut or bent with any instrument slender enough to go through a bronchoscope. The method of cephalic version by which the author first solved the exceedingly difficult problem, presented by these foreign bodies when they are lodged point upward,<sup>4</sup> has proven entirely satisfactory in seven subsequent cases,

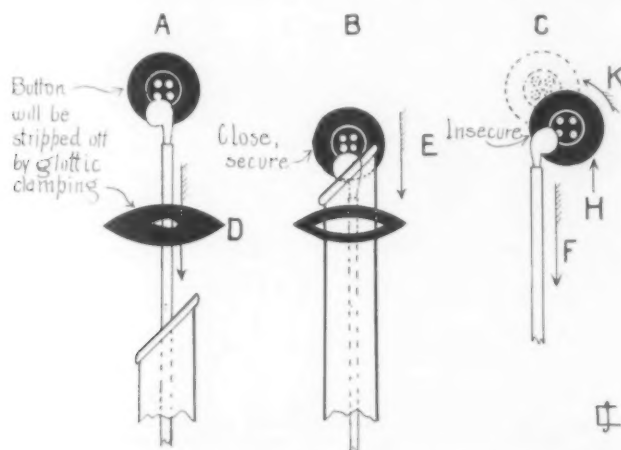


FIG. 21.—Illustrating the necessity of keeping the foreign body close to the tube-mouth during withdrawal so as to emerge with the tube (B). If allowed to trail as shown at A it will be stripped off the forceps by the glottis (D) clamping tightly around the stem of the forceps. This applies to the endoscopic removal of all foreign bodies too large to be brought out through the tube. In oesophageal work the cricopharyngeus will strip off the foreign body in the same way as the glottis does at bronchoscopy. Therefore, D, in the schema above may be taken to mean either glottic or cricopharyngeal clamping. At C is shown the fault of the one-sided grasp of any foreign body in endoscopic removal. When traction is made in the direction of the dart, F the resistance of any tissue encountered (H) by the sidewise projecting portion of the button will cause the button to be rotated in the direction K, inevitably loosening it from the grasp of the forceps. (See also Fig. 33.)

in all of which the staple was removed without mortality. The essential thing to remember in turning or otherwise manipulating these objects is that the trailing point does no harm, whereas the advancing point will rip in unless it is watched and the tissues are safely guarded. In a recent case (Fbdy. No. 825) of a staple in the trachea of a girl, aged four years, the points were found buried in the swollen subglottic tissues below the anterior and posterior commissures, respectively, the greater plane of the staple being sagittally lodged (Fig. 19). The posterior point was readily seized and advanced up out of the larynx, the anterior point being caused to trail downward as the curved head was brought upward. The head was then gently forced posteriorly against the soft-tissue wall which yielded enough to permit version. For success with staples it is essential to have beforehand

a mental conception of the staple in all its relations. For these the ray-study should be made to determine:

1. The exact length of the staple free from foreshortening.
2. The extent of the spread of the staple from point to point.
3. The plane of the greatest spread.
4. The location of the staple.
5. The degree of divergence of each of the two branches of the staple from the parallel.
6. The form, size and axis of the bronchi in the neighborhood, as shown in stereoscopic plates. If necessary, the author's method of lung-mapping by the insufflation of bismuth may be used to increase the visibility of the bronchi.

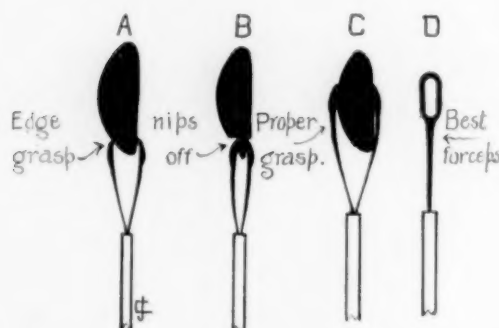


FIG. 22.—Illustrating the right and wrong ways of grasping peanut kernels and all other friable substances. If the forceps are applied close to the presenting edge (A) a fragment of the edge will be nipped off (B). With proper forceps and a gentle hand the peanut kernel will not be crushed if grasped over the minor axis, as shown at C. The author's special peanut forceps (D) have proven very satisfactory. The long soft spring of the jaws as well as the fenestra and the springless handle all contribute to gentleness of grasp with sufficient holding power.

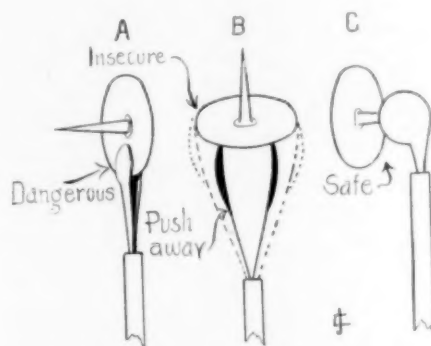


FIG. 23.—The problem of the thumb tack. If grasped as shown at A, serious and if in the oesophagus, fatal trauma will be inflicted during removal. If the flat face of the head presents, as at B, the attempt to apply the forceps will push the intruder into a lower and more difficult position; and even if the forceps were gotten over the periphery of the disk-like head as shown by the dotted lines (B) the hold would be very insecure. If the stem of the tack is grasped as at C, the hold will be secure and, most important, the point will be covered so as to protect the tissues from trauma. All other presentations should be converted into this one (C) by version with the forceps and the lip of the tube-mouth used coordinately.

*Peanut kernels* and similar friable substances, such as beans and maize, require great delicacy of touch. So exacting is this requirement that it is my rule when a series of cases at a clinic included a peanut case, always to take it first in order that delicacy may not be obtunded by any preceding work. Peanut kernels are especially friable, the friability varying with the degree of roasting and to a less extent with the degree of maceration. To crush a peanut kernel in the bronchus of a child is apt to cause multiple abscesses from the scattered aspiration of minute fragments that cannot afterward be found. This is a disaster to avoid which the utmost caution should be taken, while endeavoring to hold the peanut sufficiently securely to prevent its being stripped off at the glottis. For these friable substances I have used for years a fenestrated forceps; but have recently added to my equipment for this purpose an extremely delicate model of the plain grasping



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forceps. The jaws are very thin, as befits the small forceps spaces usually available in these cases, and a very soft spring permits of the utmost delicacy of touch. Great strength is not necessary and these forceps are carefully kept for this particularly delicate work in which they have given the utmost satisfaction. Like all other forceps they should have a covering-clamp slipped on over the jaws to keep them closed and protected when not in use, so that the jaws will not get bent backward. All forceps should be well oiled in their cannulae before putting away. Reliability in instruments depends largely upon their care. With the very delicate forceps needed to feel a peanut kernel a well cared for instrument may make all the difference between sending the baby home well in a few days and sending him home in

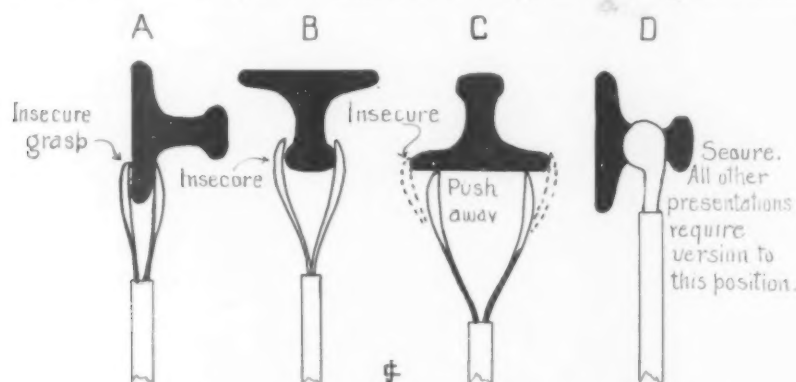


FIG. 24.—The various unfavorable presentations of the collar button and how they are converted into favorable presentations by version. At A is shown a very insecure hold; the collar button is certain to be stripped off at the glottis. At B is shown another insecure hold. In the presentation, C, it is almost impossible to grasp the collar button and the attempt is likely to push the button into a deeper and more difficult position. Even if the forceps were expanded to the position of the dotted lines the hold would be very insecure because of the tendency to tilt. At D is shown a very secure hold and in this position the collar button meets least resistance in withdrawal. All other presentations should be converted into this one by manipulation with hooks, or preferably side-curved forceps, and tube-mouth worked coordinately as knife and fork.

a box. With a delicate forceps well oiled and working smoothly in his possession the man who expects to be successful in removing peanut kernels without crushing them should crush a few quarts of peanut kernels to acquire the sense of tactile differentiation between the degree of forceps-pressure necessary securely to hold a peanut kernel during its withdrawal through the glottis and the degree of pressure that will crush it. This is a purely manual thing to be acquired only by feeling the peanuts crush and then feeling others against the tube-mouth while being withdrawn. Knowledge of how to do it is not enough. The problem is simulated for practice by inserting half of a peanut kernel in a piece of rubber tubing so small that it fits tightly. Then working through the infant size bronchoscope the forceps spaces are found, the forceps placed, and the peanut is withdrawn until it is felt to meet the distal tube-mouth. Then the forceps are clamped against the side wall of the proximal tube-mouth with the fingers (Fig. 20) so as to fix the tube, foreign body and forceps, together as one piece during with-

drawal. This method minimizes the likelihood of having the foreign body stripped off at the glottis as shown in Fig. 21. Much practice is necessary to execute this manoeuvre with soft friable bodies like peanut kernels. If pulled too strongly against the tube-mouth they will be stripped off, or worse, crushed by the tube-mouth forcing the forceps shut. One great fault I find in pupil physicians at the Bronchoscopic Clinic is the nipping off of the peanut kernel by an insufficient grasp. If the forceps close on the equator of the

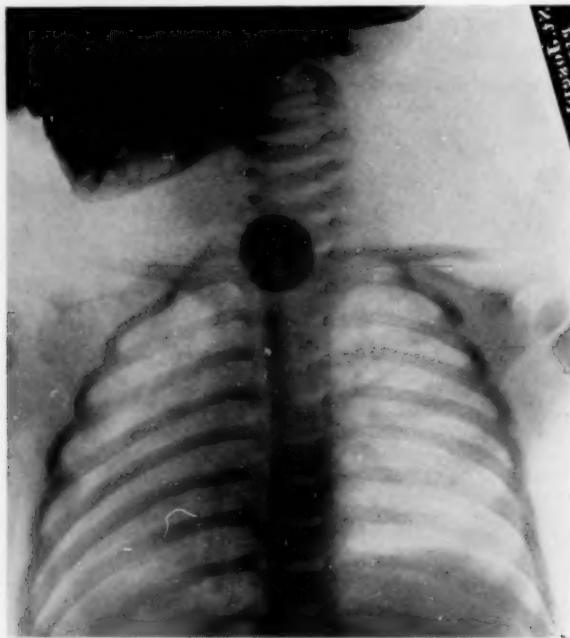


FIG. 25.—Most buttons, occurring as foreign bodies today, being made of casein, do not show. This one, of a denser composition, pearl shell, shows clearly. The mechanical problems of removal of buttons are illustrated in Figs. 21 and 26.

peanut kernel, crushing is much less likely than if the edge only is grasped (Fig. 22).

*Grains of Maize* usually present the germ-end the center of which is soft. If this germ is grasped it will come away leaving the "mouse gnawed" grain behind. To prevent this the grain should be grasped as shown at C, Fig. 22.

*Tacks, pins, needles* and similar pointed objects present problems the solution of which I described years ago.<sup>1</sup> These solutions have stood the test of many cases and have never failed to yield results. One great aid in the execution of these manipulations will be the new Tucker modification of the side-curved forceps (Fig. 7). The little projecting lips prevent the shaft from slipping out of the grasp of the forceps.

*Collar Buttons.*—The many different positions in which a collar button can present itself makes it an ideal object for practice on the rubber tube.

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It is a typical example of the value of version in converting an unfavorable presentation into a favorable one for grasping and removal, as illustrated in Fig. 24.

*Thumb tacks* present a different problem from other tacks. They also present a good illustration of how a foreign body potentially dangerous may be safely and easily removed. The dangerous and the safe ways are illustrated in Fig. 23.

*Very large foreign bodies* in the œsophagus present difficulties that have defeated many œsophagoscopists, some of whom have gone so far as to say that external œsophagotomy with its relatively high mortality is justifiable. This I feel sure is a mistake, apart from the fact that it, in any event, could only apply to foreign bodies high in the œsophagus. Formerly I thought it

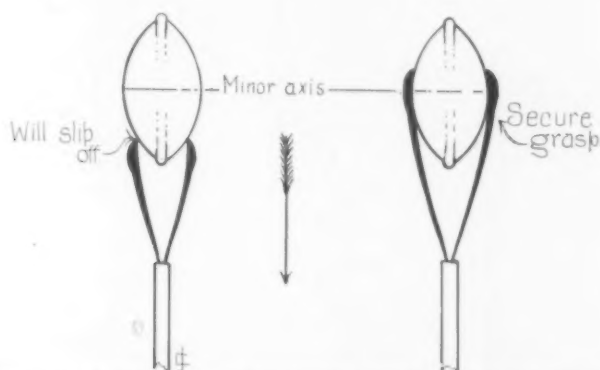


FIG. 26.—The problem of the thick, hard, smooth-surfaced foreign body of conoidal cross-section, illustrated in this instance by an ellipsoidal button. If grasped near the vertex, the forceps will slip off as soon as traction is made in the direction of the dart. To get a secure grasp, the forceps jaws must be placed beyond the minor axis of the ellipsoid, or base of the conoid, as the case may be. With spheroidal bodies, the jaw should go beyond the equator.

necessary in cases of œsophagoscopy for very large and sharp foreign bodies to relax the patient by ether anæsthesia to prevent trauma by the clamping of the foreign body by the œsophageal musculature. This I have found to be rendered quite unnecessary by the hereinafter-mentioned manipulations. Because of the development of this technic also, I have never yet had to resort to morcellation and fragmentary removal of any foreign body because of its size, though preparations for doing so have always been made. If anyone should desire to cut a foreign body it might be well to use the bouginage œsophagoscope because the increased lumen obtained by putting both the drainage and the light canals outside of the wall of the tube permits the use of large, heavy shears. Such a procedure as morcellation introduces special dangers to the patient. I have always, so far, found that any foreign body that has gone down the œsophagus could be brought back the same way, provided certain requirements are fulfilled. To have seized the large intruder with powerful forceps and dragged it out by main strength would undoubtedly have been fatal in many cases. Three precautions are necessary for safety

and success in the author's method of œsophagoscopic removal of very large foreign bodies by rotation and tubal manipulations:

1. Very careful preliminary ray-study is necessary to determine the location of any sharp corners or edges, any concavities, hooks, or other possible characters that might impede removal or cause trauma, so that such potentially traumatic factors can be eliminated by version or otherwise.

2. The largest possible œsophagoscope must be used so as to hold the œsophageal walls well spread apart during withdrawal. The œsophagoscope

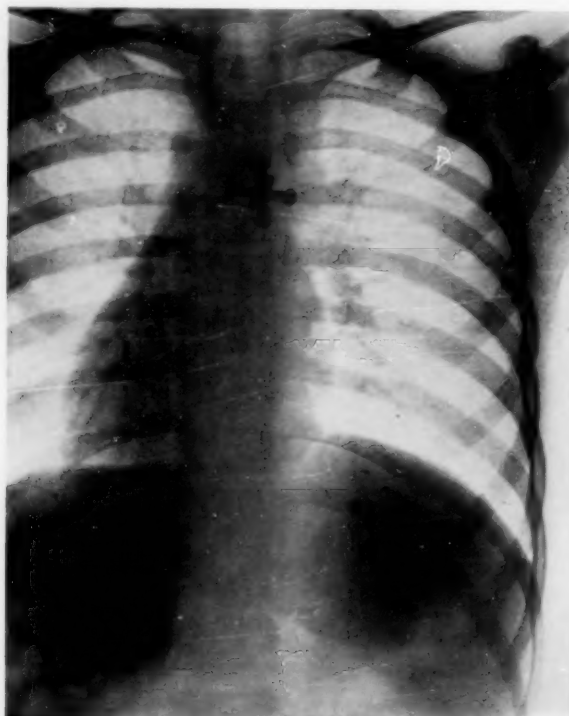


FIG. 27.—Toy jack in the œsophagus. Removal presented the problem the solution of which is illustrated in Fig. 28.

must have the regular slanted end, so as to afford the advantage of the lip in the tubal manipulation of the folds.

3. The foreign body must be brought up in the position of least resistance, doing a partial or complete version if necessary for the purpose. Rotation forceps are usually the most serviceable instruments for this purpose.

4. The foreign body must be kept close up to the tube-mouth during withdrawal for three purposes: (a) To keep the foreign body in the space of widely separated walls in the wake of the tube-mouth, (b) to keep the foreign body in view all the way up so as to enable the œsophagoscopist to carry out tubal manipulation of the collapsing folds, (c) to minimize the clamping of the intruder by the collapsing folds.

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5. A close watch for collapsing walls and clamping folds must be maintained and these must be controlled by manipulation with the lip of the slanted tube-mouth.

These methods have enabled me to remove œsophageally lodged foreign bodies in 238 consecutive cases without resort to external œsophagotomy in any case.

*Hard, Smooth Conoidal Bodies* are best dealt with as shown in Figs. 25 and 26.

*Toy Jacks* are managed as shown in Figs. 27 and 28.

*The Upper-lobe Bronchi* are rarely invaded, but in their proximal portions a foreign body is readily dealt with. When their ascending branches are invaded the difficulties of work are very great, as shown in Figs. 29, 30 and

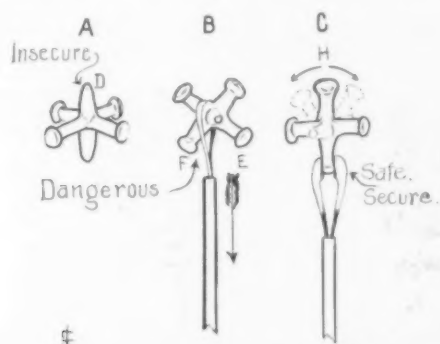


FIG. 28.—The problem of the toy jack in the œsophagus. The plain points, D, afford a very insecure grasp. The grasp with rotation forceps, B, is very secure but in this grasp the points E and F have a hook-like action similar to a graefe basket and are sure to injure the œsophageal wall by catching in a fold. The most secure grasp, and the one that should always be obtained, by version if necessary, is with a cupped forceps applied to one of the ball-points. This grasp permits wobbling (H) which permits the other points of the jack to free themselves from the fold encountered during withdrawal in direction of dart. In some cases assistance by rotation with the forceps and tube-mouth is needed to free the points.

31; but they have been to a certain extent overcome by methods being developed in collaboration with Dr. Willis F. Manges.

*Magnetic Extraction of Foreign Bodies.*—One of the most frequently asked questions is in regard to the usefulness of magnets in cases of foreign bodies in the lungs. There have been no developments since our report.\* The limitations arise from the small size of the foreign bodies and the fact that they are not free to move. The smaller the foreign body the less the magnetic attraction. If an iron or steel foreign body were the size of a sledge hammer it could be pulled out through the chest wall. The only case in which a magnet could possibly be desirable would be that of a tiny iron or steel foreign body in a branch bronchus so small that a bronchoscope could not enter, and these are precisely the cases in which magnets are useless. Inasmuch as we have now developed methods of removing all of these, as all other kinds of foreign bodies with forceps or other instruments, it would seem that magnetic extraction is not needed. Moreover, in using a

\* Jackson, Chevalier: The Laryngoscope, April, 1905.



magnet there is no control over the position of the foreign body in relation to the bronchi invaded or to be traversed in extraction. Hence all the niceties of disentanglement and version are impossible. However, all experiment, if not carried out on living human subjects, should be encouraged. The author hastens to add that these are only his personal views.

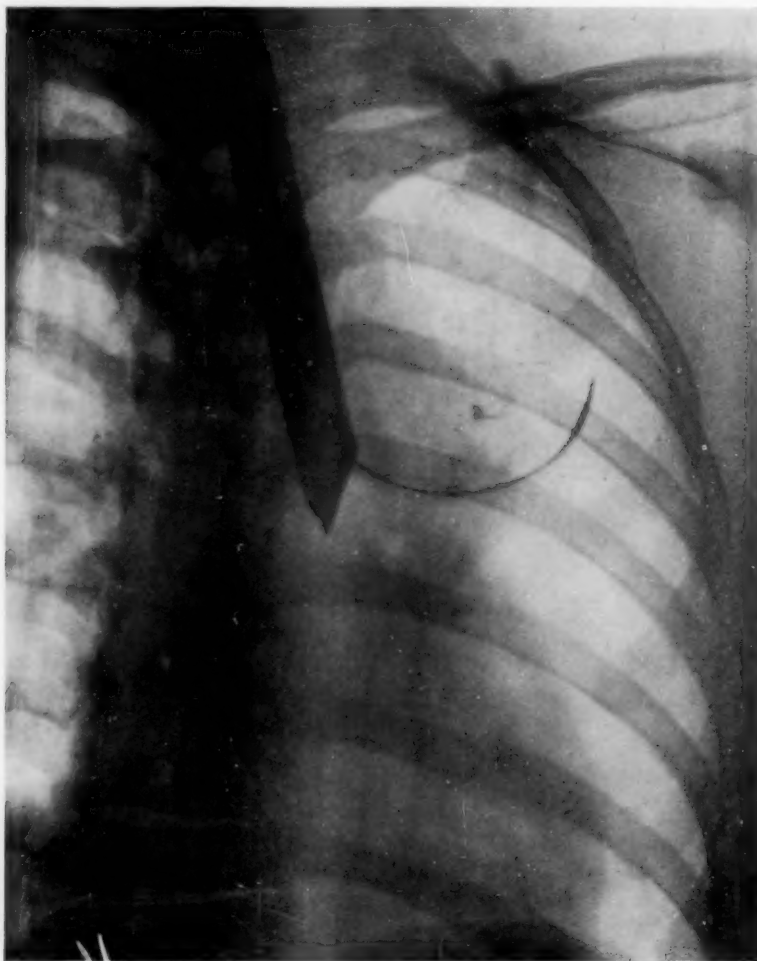


FIG. 29.—Röntgenogram showing a coil spring hook reaching "around-the-corner" into an ascending branch of the upper lobe bronchus of a patient. The hook went beyond the foreign body because this particular coil-spring was of too long a radius of curvature. This plate was made by Dr. Willis F. Manges, whose aid in the development of upper-lobe-bronchial work is gratefully acknowledged by the author.

#### CONCLUSIONS

In all cases of bronchoscopic and œsophagoscopic foreign body extraction the fundamental rule should be the avoidance of risk of mortality. Most of the operations in surgery are bimanual binocular procedures, whereas foreign-body endoscopy is a monocular, depth-gauging procedure handi-

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capped by limitations due to the smallness of the bronchi and the length and slenderness of the instruments. Differing thus from all previous training of the operator, safety and success require eyes and fingers that have been trained to the work. It is impossible, to say nothing of the inhumanity of the attempt, to get this training by work on patients. The time is insufficient. Hundreds of hours should be spent in educating the eye and the fingers with the bronchoscope working with all kinds of foreign bodies in a rubber tube, a cadaver and a living dog. Then when a case comes along a few hours preliminary working in the same way with a duplicate foreign

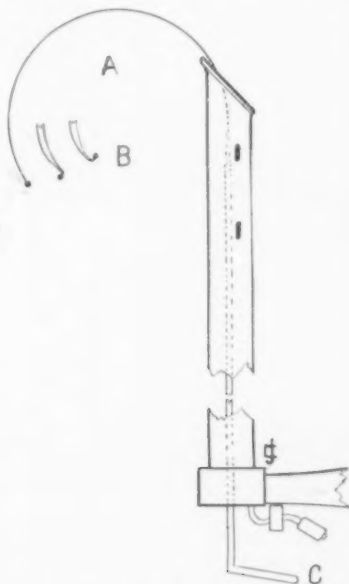


FIG. 30.—Coil-spring hooks for reaching "around-the-corner" into the ascending branches of the upper-lobe bronchus. They are straightened in their passage through the bronchoscope, resuming their curve after emergence. The degree to which this radius of curvature is permitted regulates the distance of entrance into the upper-lobe and, to some extent, the radius of curvature; though hooks of different spring-radii are provided. The hook, proper, at the extremity (B) does not exceed a right angle in its bent position. Hooks are made in various directions, but the two illustrated (B) have the advantage that, if caught, they can be disengaged by manipulation of the handle (C).

body will provide the bronchoscopist with an experience such as he could not obtain from even hundreds of cases. If this plan of preliminary general practice followed by special practice for the particular case be conscientiously carried out, I feel sure that any foreign body that has gone down the natural passages can be brought up the same way, provided the following rules for the use of forceps or other extracting instruments are followed:

### RULES FOR USE OF FORCEPS

The following rules are those formulated by the author for his own use. Hence they are stated dogmatically. The terms "must" and "should" refer only to what the author says to himself. Each operator can modify them to suit his own personal experience or equation. For convenience the

term bronchoscope is used. Almost all of the rules apply with equal force to the œsophagoscope, the œsophageal speculum and the direct laryngoscope:

1. Before insertion of forceps the long axis of the bronchoscope must be brought to correspond with that of the bronchus invaded by the foreign body.
2. The size and kind of forceps most suitable must be determined before introduction of the forceps.
3. The plane of expansion must be determined before the insertion of forceps.



FIG. 31.—Röntgenogram showing the spiral, upper-lobe bronchus forceps extending around 180 degrees in an ascending branch of the upper-lobe bronchus. Though apparently in contact with the foreign body, the forceps are in a bronchial branch about 2 cm. anterior to the foreign body. Plate made by Dr. Willis F. Manges.

4. The plane of expansion must be determined by the greatest plane of the intruder, the shape of the presenting part and the position of the forceps spaces.
5. There must be two forceps spaces, if two-jawed forceps are to be used, and they must be on opposite sides of the foreign body. If only one exists another must be made by manipulation of either the intruder or the tissues, normal or pathologic, or by working the intruder upward into a wider passage. If none exists two must be created.
6. Before applying forceps an unfavorable presentation must be converted into a favorable one by

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- (a) Creation of forceps space or spaces if only one, or none, exists.
- (b) Partial or complete version if required for disentanglement, disimpaction, disengagement of a point, or proper presentation for seizure.

7. Great care is necessary to avoid seizing tissue along with the foreign body. In the œsophagus a fold of the collapsing walls, or the cricopharyngeal fold; in the bronchi the spur between bronchial orifices, or even a duplication of the bronchial wall may be included in the grasp of the forceps. To pull, tear or twist with forceps so engaged usually means the death of the patient. If only the mucosa is nipped, fatal injury may not be inflicted, but the prolonged oozing of blood will diminish visibility by obscuring the field and by tinting the surface of the foreign body.

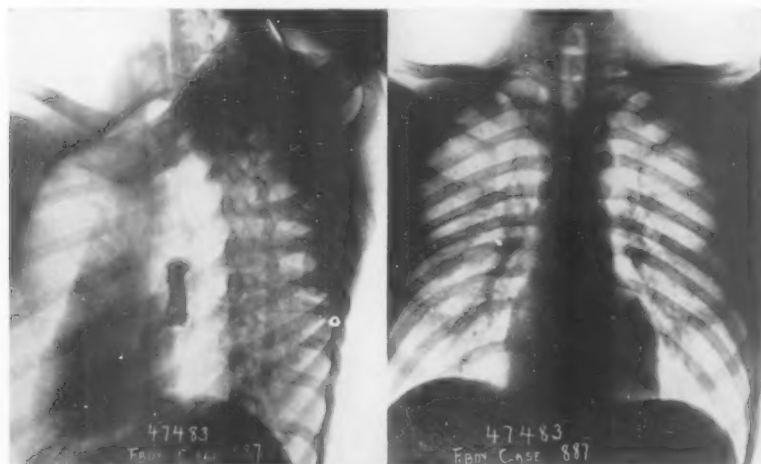


FIG. 32.—Röntgenograms anteroposterior and lateral, of a man aged 28 years (Case No. Pbdy. 887). Showing a very large artificial denture in the œsophagus which before admission could not be pulled out of the œsophagus. Removed through the mouth by œsophagoscopy without anaesthesia in 2 minutes and 11 seconds by the method illustrated in Fig. 33. Plates made by Dr. Willis F. Manges.

- 8. Traction should never be made until it is certain that the foreign body can be withdrawn without trauma to the tissues.
- 9. No matter how sure you are that the foreign body is properly seized and free to be withdrawn, never pull strongly enough to tear tissues apart. The safe degree of traction can be determined by the tactile sense trained by experiment on the cadaver.
- 10. In many instances traction must be preceded by pulsion, or by rotation, or by both, according to the mechanical problem present, in order to free a foreign body or its point.
- 11. When dealing with a pointed object, no traction should be made until the point is in the tube-mouth or is otherwise protected.
- 12. The index finger, being keenest in sense of manipulative touch, should be used for traction and propulsion of forceps. To leave it free the middle and ring fingers are inserted in the rings of the forceps.

13. In case of foreign bodies that cannot be withdrawn through the bronchoscope or œsophagoscope, the foreign body must be held closely against the distal tube-mouth by traction on the forceps until the resistance of contact is felt. Then the cannula of the forceps is firmly fixed against the side of the lumen of the proximal tube-mouth as shown in Fig. 20. This clamps the

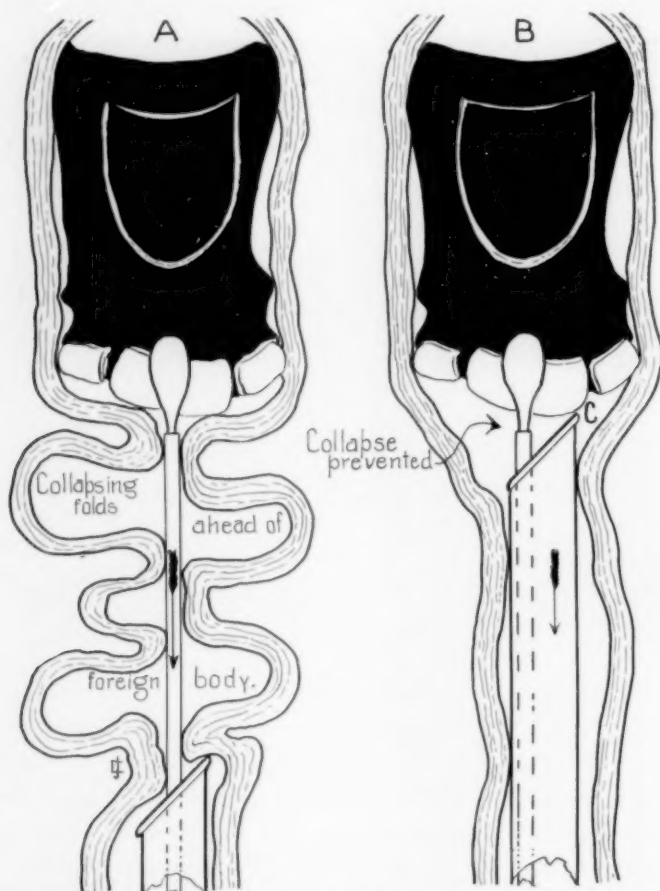


FIG. 33.—Schematic illustration of the author's method of dealing with foreign bodies of very large size in the œsophagus. In this particular case (see Fig. 32), selected for illustration, œsophagoscopy prior to admission failed because nothing short of fatal traction could bring the artificial denture through the obstructing folds (shown in illustration A), which had been allowed to collapse in around the forceps and foreign body. By bringing œsophagoscope, forceps and foreign body all out together as one piece, the foreign body close against the tube-mouth (B), a heavy collapse of folds is impossible. Any fold that catches the foreign body can be readily manipulated out of the way by the tip of the tube-mouth.

See also Figs. 20 and 21.

three elements, foreign body, bronchoscope and forceps, together as one piece, so that all come out together. If this is not done the foreign body trailing beyond the tube-mouth, as it is almost certain to do if each instrument is held independently, will permit glottic closure on the forceps cannula before



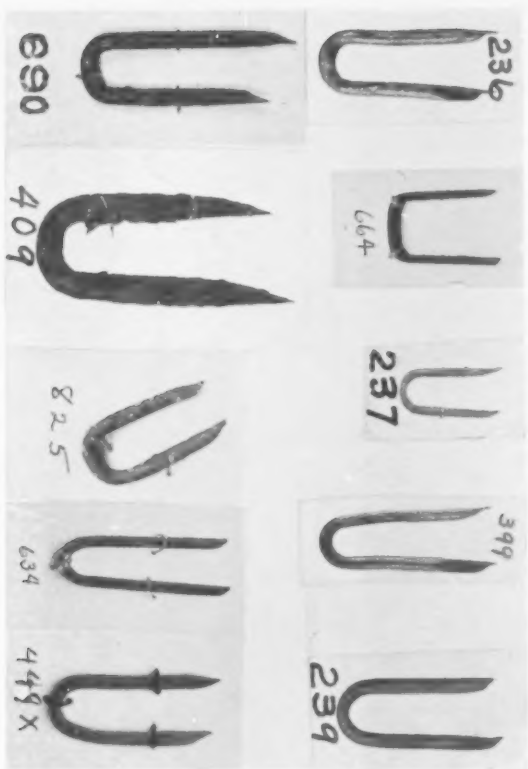


FIG. 35.—Staples endoscopically removed from the air and food passages. Foreign body No. 825 was removed by posterior laryngeal version. That is, the sharply pointed presenting bronchial or endoesophageal cephalic version. That is, the sharply pointed presenting extremities were turned back so that the staple could be safely withdrawn head first.



FIG. 36.—The safety-pin problem complicated by a button. The button and pin had been swallowed together; the metallic ring of the button was on the pointed branch of the pin; the entire foreign body mass being anchored by the point of the pin having perforated the esophageal wall and having hooked itself under the tightly contracted cricopharyngeus muscle. The keeper end of the pin was in the post-cricoid pharynx. The difficulties were increased by the size of the patient, an infant aged 10 days. The problem was solved and the pin was removed in one minute by the method illustrated in Fig. 12.

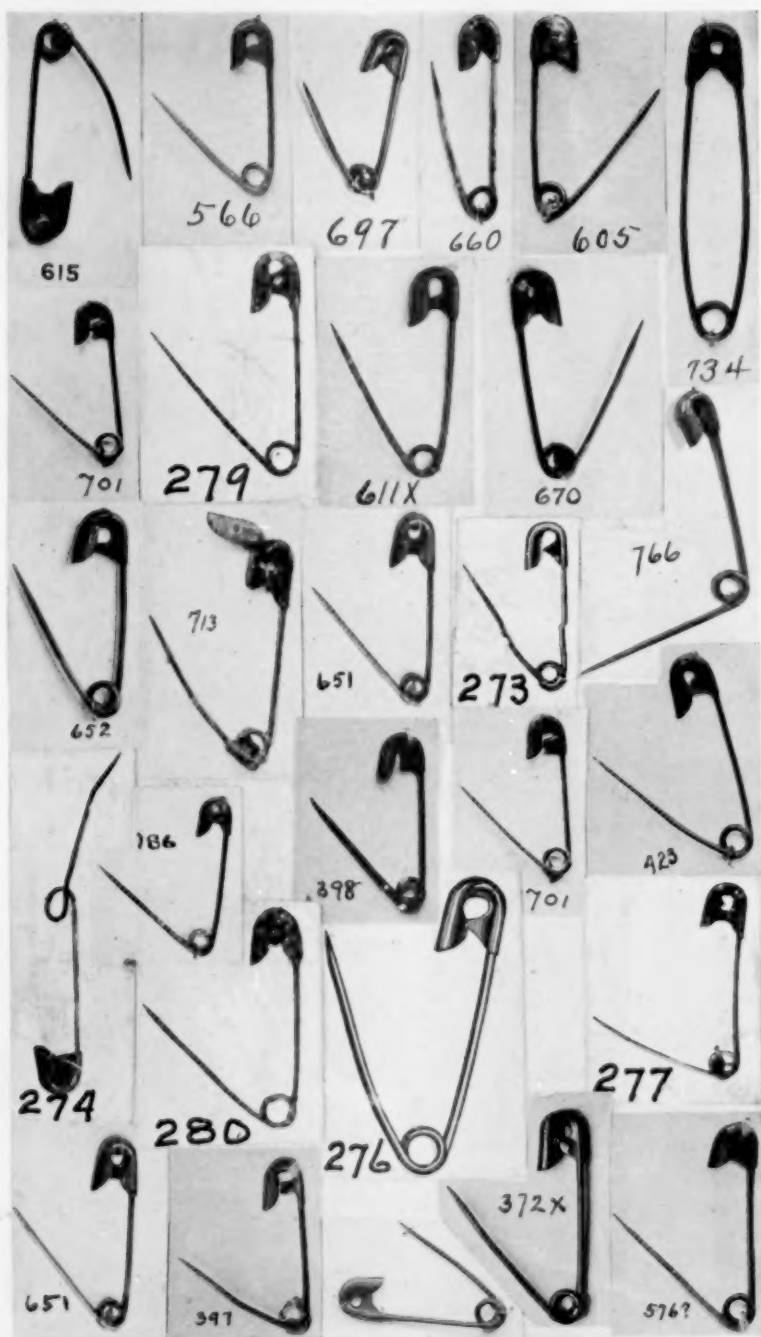


FIG. 37.—Some of the safety-pins removed from the air and food passages, at the Bronchoscopic Clinic by endoscopy through the mouth, without anesthesia. Some of the open pins were closed before removal, others were removed by the point-protecting method, and still others were removed by endoesophageal or endogastric version.

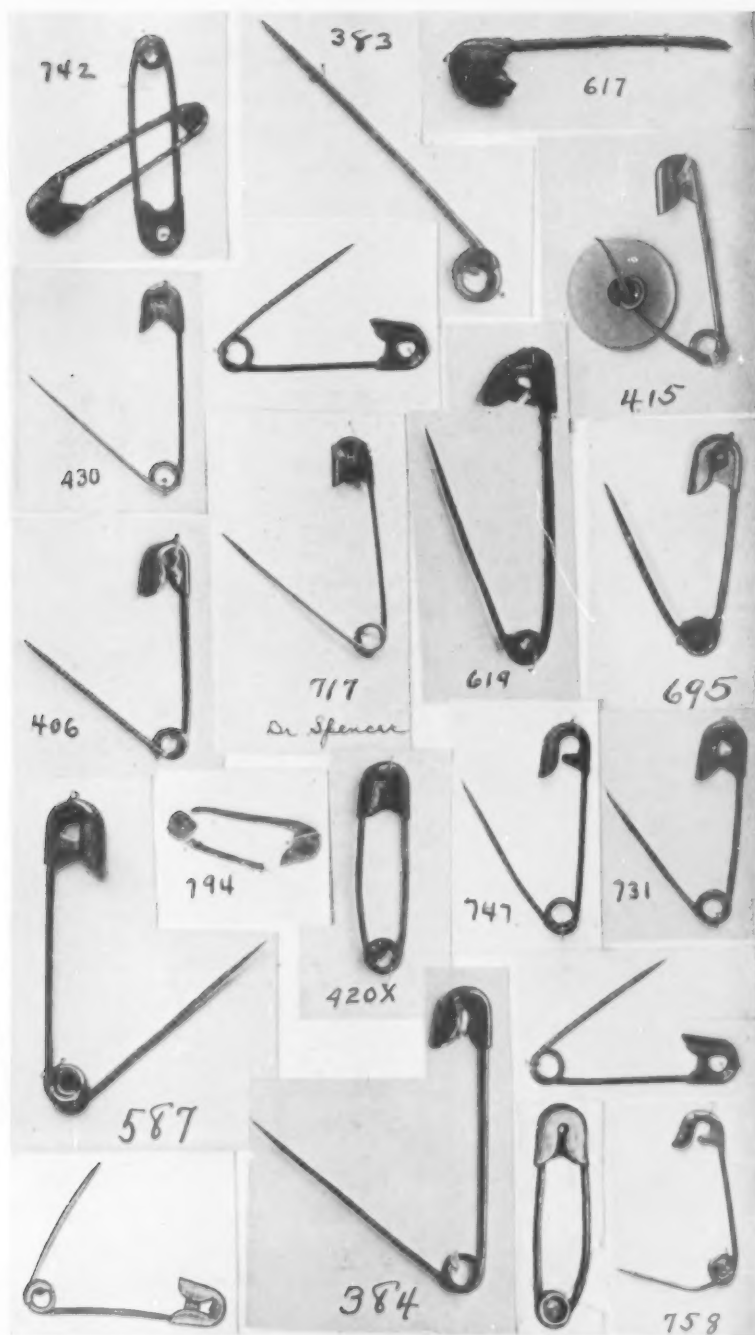


FIG. 38.—Some of the safety-pins removed from the air and food passages, at the Bronchoscopic Clinic by endoscopy through the mouth, without anæsthesia. Some of the open pins were closed before removal, others were removed by the point-protecting method, and still others were removed by endoesophageal or endogastric version.

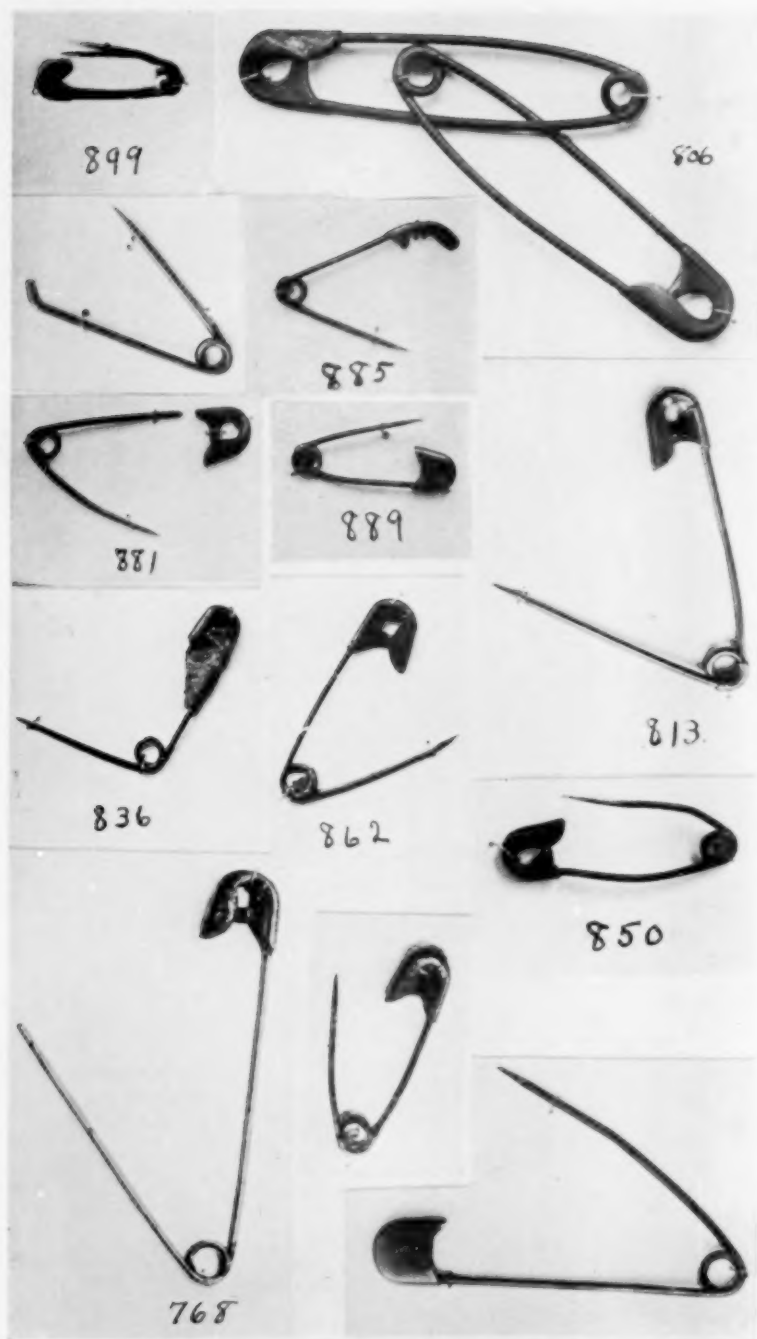


FIG. 39.—Some of the safety-pins removed from the air and food passages, at the Bronchoscopic Clinic by endoscopy through the mouth, without anaesthesia. Some of the open pins were closed before removal, others were removed by the point-protecting method, and still others were removed by endoesophageal or endogastric version.

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the foreign body reaches the glottis. The almost inevitable result is the stripping off of the foreign body (Fig. 21).

14. Before inserting forceps, the distance from the tube-mouth to the foreign body should be estimated. The jaws of the forceps going down the tube show in black silhouette against the lighted field. When the jaws reach the light they show up brightly lighted. This localization leaves only the distance from the tube-mouth to the foreign body to be estimated by depth perception.

15. Until the glint of light on the forceps is seen the jaws should never be allowed to open; and in many cases they should not be allowed to open until the intruder is reached. They should, however, open before the intruder is touched and thus displaced.

16. Peanut kernels and similar friable objects must not be grasped so firmly as to crush them. To do this and yet hold the foreign body sufficiently

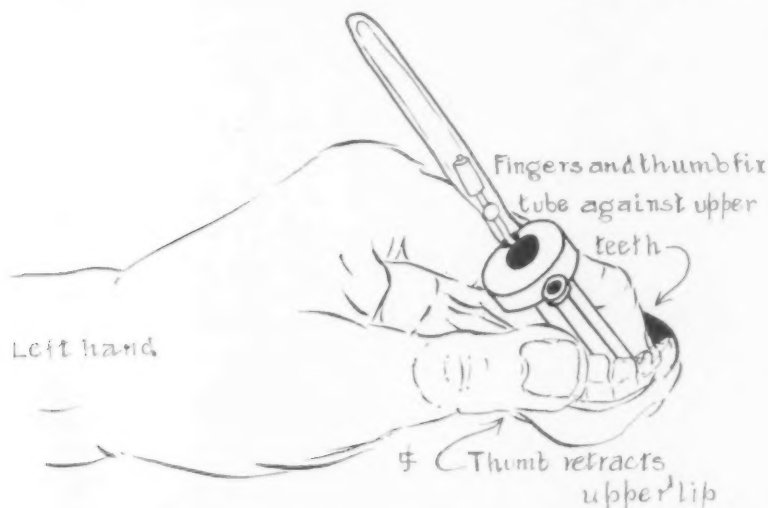


FIG. 34.—Having found the foreign body and developed the proper presentation, by version or otherwise, the tube is fixed against the upper teeth with the thumb and finger of the left hand, as here shown, in order to maintain the presentation until forceps are inserted and the foreign body is properly grasped, according to the mechanical problem presented. {Neglect of this precaution is the cause of many failures.

firmly to withdraw it requires the training to be acquired only by the preliminary practice in crushing hundreds of peanut kernels with the bronchoscopic forceps. Allowance must be made for variations in resistance to crushing according to the degree of roasting and to a slight extent the degree of maceration.

17. Because of the limitations imposed by the necessity of working at a distance through a tube with one eye only, training of the eye and the fingers to the peculiar, ocularly guided, bimanual manipulations of forceps and tube are necessary to a large percentage of successes. As with all other manual things the knowledge of how to do them is not enough. Nerve-cell habit

should be established by practice until the manipulations are made subconsciously as with the knife and fork in eating.

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## THE SURGICAL TREATMENT OF PERNICIOUS ANÆMIA\*

By JAS. MORLEY HITZROT, M.D.

OF NEW YORK, N. Y.

THE blood has offered many interesting, often elusive, problems to the profession, none perhaps more so than the anæmias grouped under the term "pernicious" anæmia.

In general two types of the anæmias are classified under the above; the aplastic anæmias and the hæmolytic anæmias. By aplastic anæmia is meant an anæmia in which there is decreased blood formation, aregeneratory anæmias (Barker). Vogel regards this form as a hemorrhagic or purpuric disease, that it is "primarily a leucomyelotoxicosis," and states that it can be produced experimentally by benzene poisoning.

The hæmolytic anæmias are of a number of types and are characterized by an excess of blood destruction over blood regeneration. The blood destructive agent for certain of the hæmolytic anæmias is more or less definitely known and the following groups are recognized:

1. Anæmia due to intestinal parasites (such as *Dibothriocephalus latus*, in which the hæmolytic agent is cholesteryl oleate). Mayo (ANNALS OF SURGERY, vol. lxxiv, 1921, p. 359) reports some observations by Logan from the Mayo Clinic upon the *Balantidium coli* as a possible cause of pernicious anæmia.

2. The hæmolytic anæmias of syphilis and of carcinoma.

3. The hæmolytic anæmias of the puerperium in which the hæmolytic agent is found in the placenta.

4. The hæmolytic anæmias due to such chemical poisons as potassium chlorate, nitrobenzene, phenyl hydrazin, the amino acids (Iwao), and oestrin (Seyderholm).

5. The hæmolytic anæmias classified as hæmolytic or acholuric jaundice which appear in both the congenital form (Chauffard-Minkowski) and the acquired form (Hayem-Widal). In both these varieties the hæmolytic agent is unknown, but it has been fairly definitely demonstrated that the pathological hæmo'lysis is closely related to some action on the part of the spleen.

In addition to the above there is still a large group of hæmolytic anæmias for which no definite causative agent can be said to have been found, and these may be classified as the Addison Biermer types of pernicious anæmia. It would be infinitely better to group them all under the term hæmolytic anæmias of unknown origin, to await the time when the etiological factor responsible for their existence has been recognized.

The diagnosis of "pernicious" anæmia may be made from the history of gradually progressive weakness with a marked anæmia in the absence of any

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\* Read before the New York Surgical Society. October 12, 1921.

recognizable disease of the internal organs. A definite diagnosis, however, depends upon the blood findings, viz. (Cabot) :

1. A reduction of the number of red cells, usually below 2,000,000 per cubic millimetre.
2. The high color index of the red cell.
3. A subnormal or normal white cell count.
4. The presence of abnormally large deformed or deeply staining red cells, some of which may be nucleated.

Cabot separates the aplastic anæmias from the general type and in his experience the aplastic anæmias occur chiefly in young women usually before the thirty-second year, run a rapid course and end fatally within a short period. The other type runs a more chronic course, is prone to remissions, and occurs much more commonly in men than in women.

Barker,<sup>1</sup> describing the Addison Biermer or hæmolytic type, considers the blood picture of this type as sometimes indistinguishable from the hæmolytic anæmias of known origin. He states that (1) it is commonest in people of middle age; (2) affects both sexes in about equal numbers; (3) the onset is insidious, the patients complaining of weakness without apparent cause, of increasing pallor (with straw-colored tint to the skin), of dyspnoea, of gastro-intestinal disturbances, and of nervous symptoms; (4) the urine is usually high colored and contains an increased amount of urobilin; (5) there is always gastric anacidity, and (6) the blood changes characteristic of a hæmolytic anæmia are demonstrable (reduced red count; anisocytosis; poikilocytosis; high color index; often regeneration signs, including nucleated red cells, polychromatic red cells and basophilic stippling; moderate leucopenia with relative lymphocytic increase, and a diminished number of platelets). There is often a little fever, but not always. He also states that the prognosis should be guarded, as sooner or later a relapse occurs which does not yield to treatment and death occurs.

In dealing with a disease in which so many factors enter as possible causes, it necessarily follows that many varieties of treatment have been tried, all with more or less efficacy in some forms. I shall have to take for granted that the various hygienic, dietetic and medicinal forms of therapy are sufficiently well known to be omitted from this paper.

The forms of treatment which are of interest to the surgeon are blood transfusions, the eradication of foci of infection, and splenectomy.

MacKenzie<sup>2</sup> points out that medical treatment has been in advance of knowledge, that treatment has been empiric, even experimental, and that knowledge has come later from the results of the attempts to palliate or cure the diseases of man. In no other field is the above more true than in the therapy of the anæmias.

Transfusion of the human blood from a selected donor whose blood is compatible has now become an established therapeutic agent, thanks to the work of Landois,<sup>3</sup> Jansky<sup>4</sup> and Moss.<sup>5</sup> The methods of transfusing the blood of the selected donor are numerous, but the two forms chiefly used

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are: (1) the direct transfusion of the undiluted blood by the syringe method popularized by Lindeman, and (2) the citrate method of Lewisohn.

The quantity of blood to be transfused is still a question for discussion. If the theory that the blood introduced from the donor stimulates the blood-forming organs, then small transfusions often repeated would seem the method of choice. If the new blood brought into the body by the transfusion brings some substance that inhibits or counteracts the action of some blood destructive agent, then the quantity would depend more or less upon the state and condition of the patient, and would have to be larger than the dose used to stimulate the blood-forming organs and might be said to be comparable to the use of the varying quantities of antitoxin in such diseases as diphtheria. By that I do not mean that there is any analogy between the two processes, but that larger quantities would be required for the severer cases.

If the theory that the introduced blood carried the donor along until his fatigued blood-forming organs had time to recover and to again begin to function properly, then the larger doses would seem to be indicated.

In this connection the life of the transfused blood-cell in its new surroundings may throw some light. In one of my cases of pernicious anæmia in which repeated small transfusions were done, it was possible to distinguish the introduced red cell for from fourteen to sixteen days at first. Later it began to disappear on the twelfth day, then the eighth to the ninth day, and at last could not be followed after the fourth day. The improvement in the condition of the patient and in the blood count coincided very closely to these periods, lasting three weeks at the beginning before a slump occurred and at last only four days when the case finally resulted fatally.

Mayo,<sup>6</sup> quoting from an unpublished paper by Ashby from the Mayo Foundation, states that the red cells of the transfused blood in persons not suffering from idiopathic blood diseases may last from one to three months.

As yet no solution as to the quantity of blood to be transfused has been reached. It has been my experience that often repeated small or moderate transfusions have been as successful as the larger ones and are less apt to cause unpleasant reactions in either the donor or the donee.

Blood transfusion has then become an added therapeutic agent in pernicious anæmia. It is a lift, acts as a temporary stay, but has not yet cured the disease. One can readily understand why that is true when we realize that this is one of the therapeutic experiments spoken of by MacKenzie to palliate human suffering.

With the recognition of the grave systemic effect of focal infections and the part played by these infections in certain diseases and the empiric effect of the removal of these infected areas in such conditions as arthritis, foci of infections are now mercilessly eradicated in anæmic patients, based upon the theory that these infections either stimulate blood destructive agencies, or that the organisms themselves form a hæmolysin which gradually gains headway

against blood formation, or like certain poisons, benzol for example, inhibit or actually destroy the blood-forming organs.

Barker, for example, feels that the treatment of infections of the gums and teeth in patients with pernicious anæmia have been so frequently followed by rapid improvement that he agrees with William Hunter that these infections play a very important rôle in the production of pernicious anæmia.

It is not uncommon to find focal infections in individuals at forty or over, but if the organism in this infected area is not of the hæmolytic strain can it be said to be more than a coincidence?

I am heartily in accord with the view that focal infections should be eradicated in anæmias, but the organism or organisms grown from the infection should have definite hæmolytic properties before they can be considered etiological agencies. The bacteriologist will undoubtedly give us much valuable information, and the field of investigation of the action of the organisms thus obtained may give much information about some of the remittent forms of pernicious anæmia which we now see.

Percy<sup>7</sup> reported twenty-four of the thirty-seven cases he had operated upon for pernicious anæmia, and reports the cultures in nine of his cases. The hæmolytic streptococcus was grown from the spleen in three cases, from other organs removed at the same time in seven out of the nine cases. He believes that, "while it is impossible to state anything definite concerning the relation of these various infections to pernicious anæmia, it is an interesting observation from the standpoint of etiology and treatment." He also believes that the rational treatment should consist of three main steps: (1) Massive step-ladder transfusions of the whole blood. (2) Splenectomy. (3) Removal of all possible sources of infection.

In none of my cases was any organism grown from the spleen, and with the exception of one case with a few suspicious teeth were there any foci of infection discoverable.

Eppinger,<sup>8</sup> Descatello,<sup>9</sup> and Klemperer and Hirschfield<sup>10</sup> used splenectomy as a therapeutic measure in pernicious anæmia. Each observer was prompted to use this method because of certain observations made after splenectomy for other conditions. Eppinger noted that splenectomy was followed by a diminished output of urobilin and by other evidences of decreased hæmolysis. Descatello, by noting the improvement which followed splenectomy in hæmolytic jaundice, and Klemperer, by noting that polycythæmia sometimes followed splenectomy for rupture of the spleen, tried splenectomy for pernicious anæmia and reported marked improvement of their cases following this procedure.

My experience covers seven cases of splenectomy done for pernicious anæmia, with three improved for periods of from one to four years, and three cases in which death resulted within a year following the operation, and one too recent to state the final outcome.

In another paper, in discussing the effect of splenectomy in pernicious anæmia, I wrote: The anæmias in which there is a disturbance of blood for-

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mation, if they can be definitely classified and recognized, cannot be benefited by splenectomy, inasmuch as the trouble does not lie in the spleen, but in the blood-forming organs.

In the other type, *i.e.*, those showing increased blood destruction, many factors as yet undetermined must be solved before the position of splenectomy as a therapeutic measure can be settled. At one end of this group one finds cases in young individuals, under forty, in which the blood picture is somewhat atypical, in which blood destruction occurs in crises (hæmatogenous crises) with periods of remission, and who have a definite enlargement of the spleen. In this variety splenectomy brings about a result comparable to that seen in the acholuric or hæmatogenous jaundice cases, and the enlarged spleen seemingly has some increased action in the process of blood destruction and its removal is followed by definite improvement if not by an actual cure.

Between these two extremes (the aplastic anæmias and the type comparable to the hæmatogenous jaundice group) is a middle group in which manifestations of inhibition of blood formation or increased blood destruction occur either separately, in conjunction, or in sequence. Just when an individual with an increased blood destruction may begin to show aplasia as a result of this constant blood destruction, or whether the factor producing the hæmolysis may likewise produce an inhibition of blood formation coincident with the increased destruction, or whether the inhibition of blood formation may produce an imperfect formation of the red cells which permits of this ready destruction, are problems to be solved. (The effect of splenectomy on the normal individual and in certain pathological conditions. *ANNALS OF SURGERY*, May, 1918.)

In a condition with so many factors which may influence our decision as to treatment, what clinical findings are there which would suggest that splenectomy might be of value? The following have impressed me as of importance:

Age: Individuals under forty-five, with an anæmia of the hæmolytic type, with attacks of blood destruction (hæmatogenous crises), with periods of remission between these crises.

The presence of a palpable spleen: The spleen is usually considered as not palpable in pernicious anæmia. The size of the spleens reported by Kumbhaar<sup>11</sup> for eighty-nine cases was, normal 28, slightly enlarged forty-one, considerably enlarged twenty. That is there was enlargement of the spleen in over 65 per cent. of the cases. He also states that the better postoperative results were obtained with the enlarged spleens. The spleen was palpable in three of my patients, questionably palpable in two, and not felt in two. The palpable cases were the largest and the non-palpable, while increased in size, were not large enough to be felt. In the other cases there was a difference of opinion among those who examined the patients as to whether the spleen could be felt or not. In all of my cases the spleen was larger than normal (265 to 500 gms.).



If the spleen is felt it is a very definite indication for removal, in my experience.

The blood findings: Lukis believes that the presence or absence of the vital staining cell is of prognostic value, *i.e.*, in the cases of anæmia in which vital staining red cells are absent, the prognosis is bad for any therapeutic measure, and conversely when they are present or increased in number the prognosis is better. It would seem wiser from the writer's limited experience to go even further than this, *i.e.*, when the vital staining cells are absent or present only in a little less than the normal ratio, splenectomy can be of little or no help. If the vital staining cells are present in an increased ratio above the normal, splenectomy should be considered.

If the blood findings show that the reticulated cell is present in less than normal ratio, blood transfusion should be done. If this increases the number of the reticulated cells, it is a help in deciding for splenectomy. If the cells are not increased by this means, splenectomy does not help.

After the splenectomy, if there is a marked increase in the reticulated cell, the case is more likely to benefit by the operation.

Minot<sup>12</sup> considers that the blood platelets give the best information as to bone-marrow activity. If they are absent or present in small numbers the bone-marrow is deficient in action. If large numbers are present the bone-marrow is active and this latter group improve most by splenectomy and transfusion. Minot, furthermore, found that the cases submitted to splenectomy benefited more and remained well longer after blood transfusion than those in which blood transfusions alone were used.

In my experience the reticulated cell has been of more help than the platelets, but my series is entirely too small to be of any great value in arriving at a decision.

Furthermore, those cases which show improvement following a transfusion and who do not return to quite the low ebb that existed before, seem to be benefited by splenectomy.

Fragility of the red cell as tested by hypotonic salt solution. Hæmolysis of the red cell by this method varies for the different types. If the red cell is less resistant than normal before splenectomy the patient will be improved by the operation, and the greatest improvement in my series occurred in the case with the most fragile red cell.

Splenectomy is contraindicated in the elderly individuals, in the cases with spinal cord symptoms, and in the aplastic cases.

In the others I believe with Percy<sup>13</sup> that transfusion, the eradication of foci of infection and splenectomy are valuable adjuncts to our present therapy.

When all our fragmentary knowledge is placed together, it becomes increasingly more evident that the anæmias are as yet but little understood. Our knowledge will be augmented by the study of all the factors above enumerated, but will require the assistance of all the laboratory, technical and chemical skill at our command to decide upon the method of treatment to be used for the given case.



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If splenectomy is to be considered I would make a plea for the early arrival at that conclusion, as the early cases do much better than those in which splenectomy is done as a last resort.

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## WOUND EXCISION AND EARLY RECONSTRUCTION IN THE TREATMENT OF COMPOUND FRACTURES\*

BY MARTIN B. TINKER, M.D.  
OF ITHACA, NEW YORK

THE important relation between wound excision and early plastic surgery was constantly in evidence with those assigned to reconstruction hospital service during the world war. Many badly mangled extremities were saved, with all structures essential to function preserved, but were almost useless because of paralysis, stiffness or contracture. This was inevitable with the difficulties unavoidable in military surgery, but much better results should be expected from similar injuries in civil practice.

Observation of conditions in a number of general hospitals in surgical centres leads to the feeling that we are not profiting by the lessons of the world war in the management of these conditions as we should. Of course, this is not true of all hospitals; but could not many hospital-bed days, much dressing material and time of internes and nurses, to say nothing of valuable lives and limbs, be saved by the adoption of the standard instructions to the resident staff as to wound excision, methods of disinfection and general measures of reconstruction by the surgical services in charge of many members of this Association? Frequently we are inclined to ask, what percentage of industrial and other accidents could have been more efficiently treated by the better surgical teams of war times? Yet such team-work and surgical care is much more readily possible in almost any of our home hospitals than in military practice in time of war. War experience showed clearly that much of such surgery need not be done personally by surgeons in charge, but could be delegated to well-trained younger men fairly instructed how to carry out the work. The yearly increasing thousands of accidents resulting from modern traffic and industrial conditions makes the most efficient management of such injuries a problem of vital importance, for the numbers in loss of life as well as function equal or exceed those in any field of pathological surgery.

As urged in a paper published over twelve years ago,<sup>1</sup> the most important consideration in the management of compound fractures is still the wound of the soft parts. "If our wound is aseptic, tetanus and blood poisoning are impossible; bony union and a movable joint (Figs. 1 and 2) are favored; osteomyelitis will not develop; and a useful, if not perfectly normal, extremity

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\* Read before the American Surgical Association, June 15, 1921.

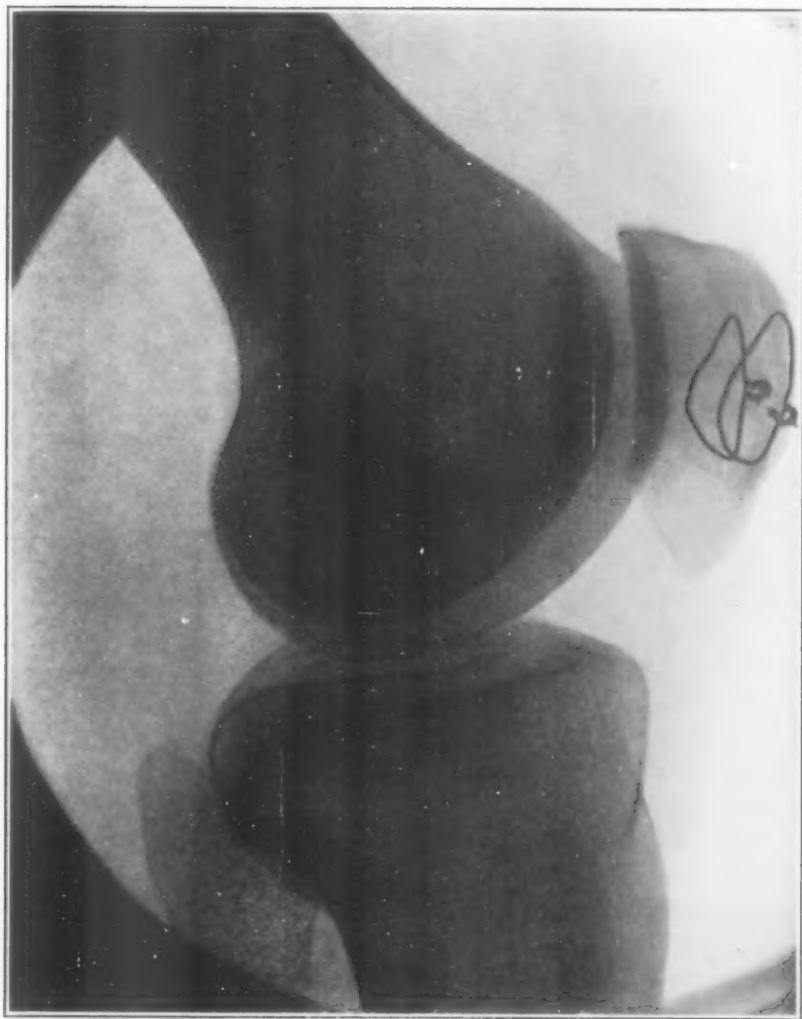


FIG. 1.—Wound excision operation performed 1905. Compound comminuted fracture of patella. Kicked in the knee by a horse. Wound contaminated with horse manure. No trouble from silver wire sutures five years after operation.



FIG. 2.—Perfect flexion of knee both voluntary and passive in fracture of patella, shown in FIG. 4. Patient able to do all kinds of farm work without any disability.

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will usually be saved." The importance of various measures of reconstruction is equally important. Unless we can save or restore the main nerve or blood supply the extremity must be sacrificed. The importance of preserving the function of tendons and certain joints is almost equally great. The ideal, where possible, is to carry out necessary reconstruction procedures at the time of excision.

With regard to wound excision itself the question arises, were the best methods used where possible during the war, and are they now being used? To help throw light on this question, some experiments were done in the laboratories of physiology, bacteriology and histology of Cornell University and New York State Veterinary College. I take this opportunity to acknowledge my indebtedness to Profs. Sutherland and Simpson, B. F. Kingsbury and V. A. Moore and their associates, Prof. H. J. Milks and Doctors Carpenter and Hitchcock. The problems which we undertook to solve were as follows:

1. Is it possible to disinfect an extensively infected wound, especially the external wound, thus preventing contamination of the clean excised area during excision?
2. What is the relative value of various antiseptics (*a*) in killing bacteria, and (*b*) in penetrating lacerated and contused tissue?
3. Is it possible so to stain lacerated tissue as to be of material help in outlining the injured from the uninjured tissue?

*First.* In the attempt to solve the first question as to the disinfection of infected wounds, animals which were used in experimental physiology were first killed with an anæsthetic. Extensive lacerated and contused wounds were then made by driving a rusty bolt into the tissues with a mallet, by crushing the extremities in a vise against a rough stone, and by tearing with a large rusty hook. The rusty bolt, hook and stone used in making these wounds were all thoroughly contaminated with a culture of a very resistant spore-forming organism. To attempt to disinfect these badly lacerated, contused and definitely contaminated wounds the following antiseptics were tested: (*a*) Saturated solution of permanganate of potassium (this was used because of its oxidizing value with special reference to the anaërobic spore-formers); (*b*) pure carbolic acid solution; (*c*) strong formaldehyde solution; (*d*) Harrington's solution (1 to 500 bichloride of mercury in 90 per cent. alcohol with 2 per cent. hydrochloric acid) and dichloramine-T 5 per cent. The wounds were thoroughly swabbed with one of the above strong antiseptics. The results were as follows:

*Wound No. 1.* Potassium permanganate. Stone. All three tubes show heavy growths of *B. Chauveau*.

*Wound No. 2.* Carbolic acid. Bolt. All three tubes show growths of organism: No. 1, three colonies; No. 2, nine colonies; No. 3, twelve colonies.

*Wound No. 3.* Harrington's solution. Hook. Two tubes negative; one tube shows one colony.

*Wound No. 4.* Carbolic acid. Bone crushed. Three tubes show growths of organism: No. 1, three colonies; No. 2, eleven colonies; No. 3, sixteen colonies.

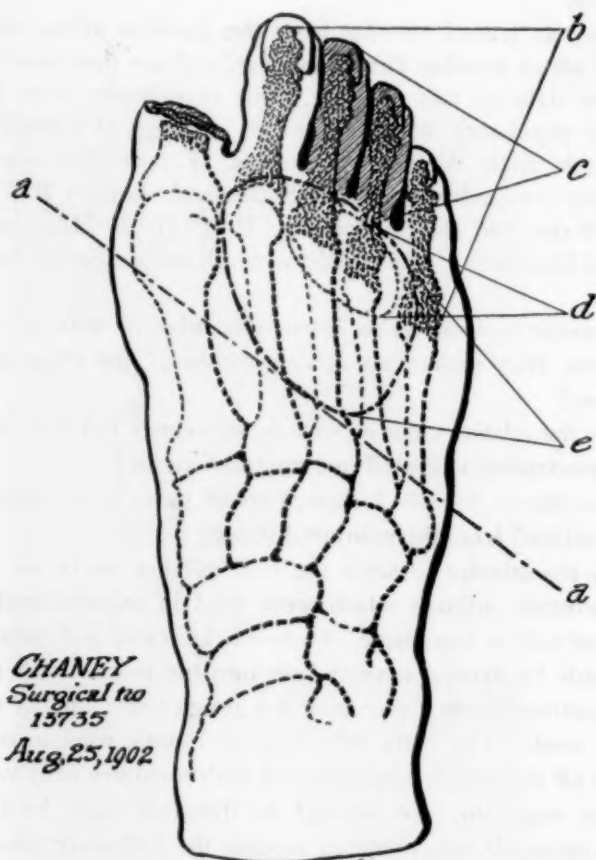


FIG. 3.—DIAGNOSIS.—Right Foot crushed with railway car wheel. Two middle toes black and gangrenous. a. Direction in which wheel passed. b. Area of crushed bone. c. Area that was gangrenous. d. Area on plantar side of foot where soft parts were entirely destroyed. e. Area on dorsal side of foot where skin was stripped off and destroyed and tendons exposed.

*Wound No. 5.* Formaldehyde Bolt. No. 1, negative; No. 2, one colony; No. 3, heavy growth throughout the tube.

*Wound No. 6.* Dichloramine-T. Bolt. No. 1, sixteen colonies; Nos. 2 and 3, heavy growth throughout the tube.

The relatively small series of tests indicated superiority of Harrington's solution and considerable value for formaldehyde solution and pure carbolic acid, but it seems that permanganate of potassium cannot be relied upon in spite of its strong oxidizing value and dichloramine-T also did not give good results.



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*Second.* To determine the extent of penetration of the antiseptic into lacerated and contused tissue, frozen sections of excised tissue were made and examined, which showed that, while the degree of penetration is not

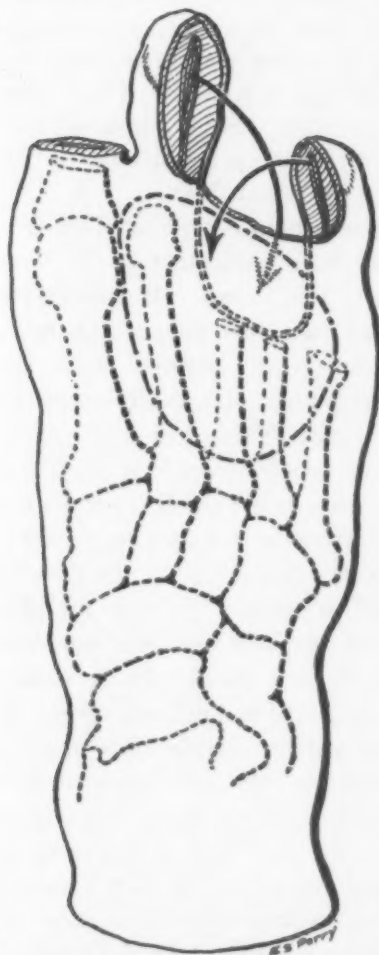


FIG. 4.—OPERATION.—Amputation of 1st and part of 2nd joint of big toe and of 3rd and 4th toes. Removal of crushed bone of 2nd and 5th toes. Soft part of 2nd and 5th toes saved for flaps.

great, it is probably sufficient to take care of practically all bacteria in case the infection has not been in contact with the tissues too long, giving the bacteria an opportunity to spread by lymphatic or blood channels.

*Third.* To determine the possibility of outlining the injured from the uninjured tissue the following stains were used: Strong solutions of acriflavine, methylene blue and hot saturated solution of permanganate of potassium. The distinction between stained and unstained tissue was clear enough

with any of the stains to be of great help in dissecting out the injured area, but the permanganate solution gave easily the best results. These experiments with stains merely confirmed similar ones carried out with medical officers at Ft. Riley and the results of clinical experience in civil practice in staining lacerated wounds, sinuses and fistulous tracts for excision. Anyone who has seen the difference between excision of an unstained fistulous tract and one stained to stand out from the surrounding tissues as clear as a shoestring would not be difficult to convince of the value of tissue-staining in outlining irregular penetrating wounds for excision. These methods I have used and advocated for fifteen years and am certain will prove a help to any not using them who will adopt them.

*Local anæsthesia* if properly used is most satisfactory in the vast majority of cases. It was used in a large percentage of the reconstruction work at General Hospital No. 26, Ft. Des Moines. Wound excision and reconstruction measures in many cases are very time-consuming, and by the use of local anæsthesia the risks are greatly reduced. Crile has demonstrated the value of local anæsthesia in combination with gas-oxygen in preventing shock; but if properly used, local anæsthesia alone gives relief from pain which is satisfactory to the patient. As is desirable in any line of surgery, so with local anæsthesia, it is necessary to get the best results to study the methods and observe the work of those accustomed to its use. Those who have attempted local anæsthesia in major surgery without such study and observation have frequently failed to get relief of pain and discarded the method without a fair trial. A minority have used local anæsthesia for many years and have proved its value beyond question in the class of cases which we are now considering. In both civil and military surgery it has the advantage of saving anæsthetic drugs and the services of a special anæsthetist for the administration of the anæsthetic. In many cases of compound fracture of the extremities it is possible to block the nerves supplying the field with relatively little anæsthetic solution. Both in this way and in certain other cases, by the massive infiltration, as used by Farr, I have succeeded in getting satisfactory anæsthesia. It is true that in certain very extensive and tedious cases the inhibition of the patient partially wears out after an hour or two, but a great deal of time under general anæsthesia can almost invariably be saved.

*Skin Grafts.* In the case of superficial injury, when no important structures are exposed, *immediate* or early skin-grafting saves a great deal of time in healing. The modified autogenous graft, a name which I coined ten years ago for want of a better,<sup>2</sup> requires only a small superficial denudation which rapidly heals. The use of local anæsthesia makes this a very minor procedure in most cases, and because of the relatively small amount of skin required it is generally unnecessary to go to distant parts of the body to

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get skin. The grafts resemble the "deep, small grafts" of Staige Davis, but the method of using them seems to me simpler. A line of skin is infiltrated and the skin pinched up in a roll between the thumb and finger of the operator and assistant. A long strip of skin, thin at the edges but thick in the middle, can then be cut easily with any sharp scalpel and snipped off in pieces one-

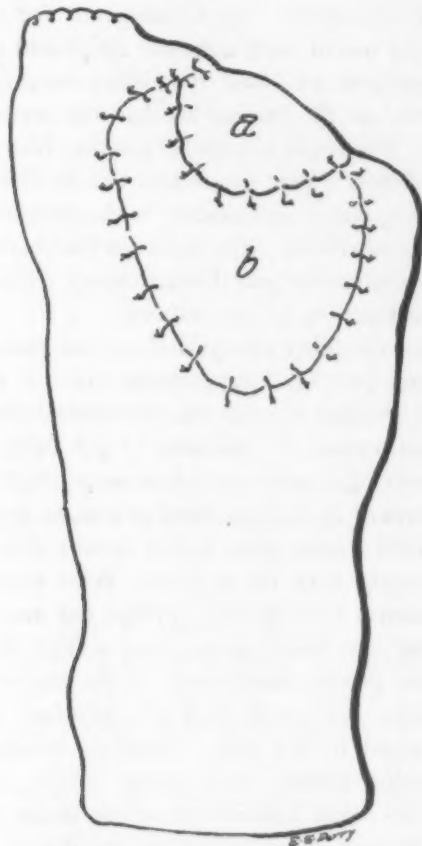


FIG. 5.—a. Soft parts of 5th toe turned over and across as flap to cover over ends of 3rd and 4th metatarsal bones. b. Skin graft from thigh over defective area.

half inch or less square. (These are supplied as islands about one-quarter inch apart to the surface it is desired to cover and usually rapidly grow together.) With free drainage and the use of mild antiseptics the grafts usually hold even in the presence of considerable infection.

*Flaps.* When nerve trunks, tendons and joints are exposed, skin grafts do not offer sufficient protection. A pedicled flap of skin with a little underlying subcutaneous fat gives the best results. If there has not been too great local destruction of the skin the flap may be turned from the immediate vicinity. In case of extensive destruction of soft parts of the arm, a flap

from the chest or, less desirable, the abdomen may be used. Pedicled flaps turned from the chest or upper abdomen are not used as frequently as they might be with advantage in the management of injuries with considerable loss of the soft parts of the hand or forearm. A full-thickness flap of almost any size or shape with ample subcutaneous fat can be readily obtained from the chest or abdomen without causing later disability. The flap becomes well established in about eighteen days, when it can be cut free and adjusted if necessary. As a substitute for plaster-of-Paris or other rigid dressing, the use of wide adhesive strips and small pillows under a binder to support the arm we found in military surgery much more comfortable for the patient, and the fixation all that was necessary for healing-in of the flap (Fig. 10). The slight change of position from occasional adjustment of the binder and very elastic support of this fixation made the patients so comfortable that complaints with regard to the dressing were unusual, in great contrast to plaster-of-Paris. The defect in the chest-wall can be closed with tension sutures of silkworm gut through heavy rubber tubing, or something similar, to prevent cutting of the sutures.

*Tendons.*—Extreme disability always follows compound fractures of the hand or forearm in case prolonged suppuration involves the tendon sheaths. If by thorough wound excision or early effective disinfection by Carrel-Dakin treatment or other antiseptics it is possible to get fairly early healing, the results of injuries involving tendons are often surprisingly good. In dealing with compound fractures of the fingers, hand or arm, an incision along the side following up the divided tendon gives better results than an incision, as so commonly placed, directly over the tendon. With incision directly down through the tendon sheath it frequently springs out and becomes adherent, and in many cases the scar tissue alone gives a high degree of disability. Better still, an incision placed transversely in the line of the normal skin-folds gives more satisfactory results than a longitudinal incision if sufficient exposure can be obtained in this way. Mattress stitches in dealing with thin tendons or muscles usually hold, while simple interrupted stitches frequently cut out. So many failures to secure union of tendons by the use of catgut sutures have come to my notice that I feel that the use of silk or some other unabsorbable material should be urged. In case a tendon has retracted far up, it is frequently possible to reach the end with a Halsted mosquito clamp inserted into the tendon sheath, grasp it and draw it down, a much more satisfactory method than division of the sheath. Splinting or other measures necessary to hold the parts in such position as to avoid tension is desirable but should not be continued long. Usually I begin some movements at the end of a week or two, at the latest three weeks. In case repair is not possible until weeks or later, the retracted upper end of the tendon is usually adherent to the sheath, making the opening of the sheath and separation of adhesions unavoidable. In such cases, bowstring



FIG. 6.—Compound comminuted fracture of humerus. Arm run over by freight car and bone crushed into minute fragments over width of car wheel. Attempt to suture with silver wire unsuccessful, but wire caused no trouble. Bone grafting refused.

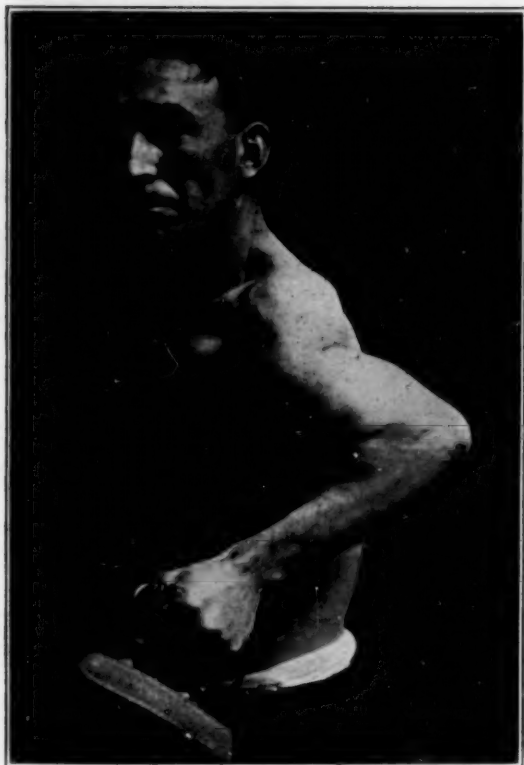


FIG. 7.—Functional result after injury shown in FIG. 6. Flail-joint weakens arm but patient is able to work as freight conductor.



FIG. 8.—Illustrating importance of dealing with wounds of soft parts in case of compound fractures. Patient had a bad compound comminuted fracture following kick by army mule. Complete paralysis of musculospiral nerve which was caught over a small spur of bone in the callus. Patient had complete voluntary extension of the wrist and fingers three months after freeing nerve.





FIG. 9.—Gunshot injury of right forearm with extensive destruction of overlying soft parts exposing extensor tendons; one-third shaft of ulna shot away; about 7 cm. of ulnar nerve exposed. Illustration shows flaps turned from radial to ulnar side of forearm to cover exposed tendons; autogenous grafts obtained by taking two strips of skin from forearm above; flap was turned; paralysis of ulnar nerve shown by atrophy of interossei and inability to hold paper by adductors of thumb with right hand. Later at second operation ulnar nerve transplanted in front of condyle of humerus and sutured and pedicle flap from chest to supply skin and soft parts to cover bone graft of ulna, third operation. Good functional arm reported by letter two years after injury.



FIG. 10.—Pedicled flaps from chest to replace extensive destruction of soft parts of forearm. Greater comfort of patient and adequate immobilization by using binder and heavy pads or small pillows and broad adhesive straps instead of plaster-of-Paris.



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contracture tends to follow tendon suture with considerable resulting disability. Avoiding incision directly down through skin and sheath and early physiotherapy help to avoid this. Tendon-lengthening by various methods has not given me as good satisfaction as direct suture, even where joints have had to be extremely flexed in order to get apposition of the ends which had been separated for a long time. In injuries of longer standing the use of free fat transplanted under adherent tendons and covering with a pedicle flap, including a fair amount of fat, frequently give excellent results where there has been loss of function because of adhesions. This is, of course, usually avoidable if reconstructive measures can be carried out early. The value of physiotherapy immobilizing fingers and joints which have been stiffened is well enough understood not to need more than mention. The importance of tendon repair is most appreciated by persons who use their fingers and hands for highly skilled work. Among my patients have been a number of musicians, including a cellist, flutist and pianist, who were completely incapacitated from playing their instruments by reason of relatively trifling injuries involving tendons. These patients have been able to play as well as ever in a short time after the suitable measures for repair.

*Peripheral Nerve Injuries* are common in connection with crushing injuries, gunshot wounds and other causes of compound fracture. The importance of early reconstruction work in these injuries was another of the important lessons taught by the experience of the world war. The records of Dr. E. M. Hummel showed that over 600 peripheral nerve injuries came under observation during nine months following August, 1918, at Ft. Des Moines. Those patients who had had immediate nerve sutures at the front, in several instances, had early return of function. In other instances, partial function was recovered, and in all these cases the secondary operation was made much easier and the prospect of recovery of function greatly improved. Even in case of wounds which became infected the nerve frequently held together, making later reconstruction surgery much simpler. In over 90 per cent. of the cases in which peripheral nerve operations were performed local anæsthesia was used for an hour or more of the tedious dissection which was usually required to free the nerve and its branches from scar tissue. The patients were made the judges of the efficacy of the anæsthesia, and if any complaint was made a general anæsthetic was administered at once. The large majority of the patients were entirely satisfied with local anæsthesia and the work demonstrated to many skeptical reserve officers the possibilities of local anæsthesia in difficult major surgery. Compound fractures with open wounds which came to us infected were rendered relatively bacteria-free within a short time, in many cases, by careful use of the Carrel-Dakin method, making it possible to skin-graft or turn flaps and get rapid and satisfactory healing of the wound and soft parts. Such reconstruction surgery, making possible the restoration of function to muscles and tendons whose

movements are controlled by the injured nerves, is equally as important as the repair of the injured nerve. In discussing peripheral nerve injuries elsewhere I have called attention to this important interrelation of function. In a few cases in which secondary operations were necessary, we demonstrated to our satisfaction the value of transplanted fat in preventing adhesions and pressure on tendons and nerves. In certain doubtful cases neurolysis was done, freeing the nerve from surrounding scar-tissue, and in case it was not possible to place it where readhesion was not almost certain to occur the nerve was surrounded by a fat flap. In several of these cases where function did not return within a reasonable time the injured area was excised and nerve suture done. In these cases, without exception, the transplanted fat was found in good condition and capable of serving the purpose for which it was used. If nerve function can be restored early a great deal of disability from fibrous changes in muscles can be avoided, as well as tedious freeing of contractures by the various means of physiotherapy. Of course, when contracture or stiffness has developed, the physiotherapy is of great value; but by early reconstruction surgery such disability usually can be avoided, with saving of time and frequently the difference between a relatively perfect and imperfect result. The autotransplants of Huber (nerve-grafts) have been shown by experience of several observers to give a fair percentage of successes when too much nerve was destroyed to permit of immediate suture by any method. This statement is made on the basis of personal experience and reports of other reliable observers, with all respect for the opinions to the contrary of some good neurological surgeons.

*Bone.* The rule should be, "Save all that is possible." Army experience showed many useful extremities following infected compound fracture with comminution into almost innumerable small fragments. Carrel-Dakin treatment is of great value if impossible to clean the wound by excision without too great sacrifice. Covering exposed bone with a flap immediately or early should be done if possible, but recent experience shows considerable exposed bone may recover under Carrel-Dakin treatment and the fragments form a strong shaft. A fairly useful extremity may be obtained even if a considerable part of the shaft of the long bone is destroyed which is not replaced by bone-graft. Methods of fixation depend largely on choice of the individual, but the army type of splint is well adapted for dressing reconstruction cases. Bone-grafting gave uniformly good results in the hands of many surgeons in the war and it scarcely demands extended comment.

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## SPECIAL POINTS IN THE TECHNIC OF OPERATIONS ON THE THYROID GLAND

BY GEORGE W. CRILE, M.D.

AND

WILLIAM E. LOWER, M.D.

OF CLEVELAND, OHIO

*How Much Gland Shall Be Left?* The amount of gland to be left varies according to the type of goiter. A block of hyperplastic gland (exophthalmic), half an inch square, and an inch long, would probably have as much functional value as a piece of colloid gland ten times as large, for the reason that the hyperplastic gland consists almost entirely of large columnar cells, while the colloid goiter is made up mainly of colloid material and a single layer of cubical cells. The amount to be left should in general be the functional equivalent of a normal gland. This would mean only a small portion of an exophthalmic gland; but in the case of a large colloid goiter, a bulk larger than that of a normal thyroid is required because the colloid goiter is not as active as the normal gland.

In our earlier operations we usually erred by leaving too much of the gland. It was only by trial and error that we finally realized that in cases of exophthalmic goiter a very small amount of gland is sufficient.

*What Part of the Gland not to Leave.* In our earlier series we followed Kocher's advice and removed the larger lobe, leaving intact the smaller lobe, expecting that the readjustment of the trachea, larynx, and the smaller lobe would be satisfactory to the patient. For cosmetic reasons this proved very unsatisfactory to the average American patient and we were sometimes obliged to resect the remaining lobe. Then we resected both lobes—leaving the posterior capsule (C. H. Mayo) and only a portion of the upper and of the lower poles on each side, believing that thus the parathyroids would be well protected, and the gland well distributed. Though this was better than unilateral thyroidectomy, the poles would too often display themselves as lumps. This plan was not entirely satisfactory.

In our first series, unless it was enlarged, the *median lobe was left*. We soon found, however, that occasionally after operation this quiescent lobe increases markedly in size, giving the appearance of an Adam's apple, which in the case of women, in particular, proved unpopular. As a matter of precaution this lobe is now routinely removed.

*Line of Division of the Preglandular Muscles.* We have dealt with the preglandular muscles in many different ways. A long vertical median incision, depending on lateral traction for exposure of the gland, was soon abandoned, except for adenomata occupying a median position or for small goiters. For laterally developed lobes, and in exophthalmic goiter, the single median division of the preglandular muscles is too often unsatisfactory.

We have tried the high division of the muscle, employed by C. H. Mayo.



For the majority of cases this gives adequate exposure, but in some goiters it does not always give adequate opportunity for the dissection of the lower pole.

It is for these reasons that, when more than a vertical incision is required, we have adopted the transverse division.

*Tying the four arteries outside the capsule* occasionally results in parathyroid deficiency because of the limitation of their blood supply. In about one hundred cases I made a bloodless, sharp knife separation of the true capsule from the surrounding tissues, whereby the parathyroid and the recurrent nerves were plainly exposed and were, therefore, left anatomically safe. From the anatomical and dissectional point of view, this is a perfect technic; but it has one defect which condemns it—occasionally, although the voice was little or not at all disturbed for some days after the operation, a hoarseness appeared later and persisted in spite of every form of treatment. This was presumably due to involvement of the recurrent nerve in the new scar tissue.

*Catching of masses of thyroid tissue by large forceps* and then ligating them by needle and catgut *en masse* was tried as a means of minimizing the number of ligatures and cutting down the time of operation. From these two standpoints, this manœuvre proved a great success; but the pulling together of such a mass of tissue occasionally interfered with the voice. This method was, therefore, abandoned and the more detailed method of catching the individual branches of the main vessels with small forceps was adopted.

*Turning Out Gland with Finger.*—In our earlier series, after the gland was freely exposed, the forefinger was slipped behind or below or above it, and the deeply lying gland rolled out into view, thus greatly simplifying the operation. This did well in most cases, but in the case of a *bilateral*, deeply burrowing goiter, especially if it is wedged tightly in behind the larynx to that considerable force is necessary to dislodge it, the mere traction and pressure and stretching—that is to say, the mechanical abuse of the recurrent nerves—even though they are not torn, may block the passage of nerve impulses and hence may cause an immediate bilateral paralysis of the vocal cords, which will interfere with or completely block the intake of air, necessitating an immediate tracheotomy. Or, in the case of a partial paralysis, respiratory distress may occur after the operation, necessitating the reopening of the wound, even a tracheotomy. The actual number of such *contretemps* may be few; but one such case seems the equivalent of many in the impression it makes, more especially if, following the tracheotomy, broncho-pneumonia and later death ensue in an otherwise sound and curable patient.

There is another objection to this otherwise highly desirable manœuvre—the turning out of a large thyroid from its burrow with the finger, which applies especially to cases in which the lower pole extends into the chest. In such a case everything may be progressing well, the projecting lobe is rolled out carefully, but just as the manœuvre is completed, a large vein, greatly



stretched, tears, and a full stream of venous blood fills the hole vacated by the ousted lobe. The entire field is at once stained and blood-soaked. The particular vessel is not seen. Promiscuous grasping with forceps in this black pool is a gamble. Packing the entire cavity with gauze will quickly arrest the hemorrhage, but meanwhile the mechanical process of gauze packing has torn neighboring, equally thin-walled veins, which are waiting their opportunity to bleed when the gauze is removed. Everyone gets out of this predicament in his own way, and his own way is usually different in each case. The best method is *prevention* by a controlled technic, which implies grasping every vessel in advance of its rupture and the primary separation of the upper attachment of the lobe so that the thyroid will rise spontaneously with but slight *pull* from above, not *push* from below.

*Catching and Tying Bleeding Vessels on the Surface of the Trachea.*—If the dissection is carried directly on the trachea or larynx, and vessels are so divided that they can be caught only by picking up and tying the peritracheal fascia with the vessel, thus including the sensory nerves which enter the wall of the trachea, the brain interprets this the same as a foreign body in the trachea. There will be irritation, coughing, increased mucus. If there is increased mucus and coughing, a local tracheitis will occasionally develop. A local tracheitis in turn will occasionally terminate in bronchitis. Bronchitis occasionally develops into broncho-pneumonia. Broncho-pneumonia may terminate in death. Thus an innocent ligature may cause death.

Contact with the trachea and the larynx may be wholly avoided by a sharp, bloodless dissection above the line of cleavage, and hence at a sufficient distance from the trachea and larynx to tie the vessels, without including the sensory nerves of the trachea, leaving on the trachea an undisturbed biologic coat. This is a most important point.

*Interference with the Mechanism of Swallowing.*—In cases in which a growth is thrust backward on each side behind the larynx, and between it and the oesophagus and the pharynx, if the encircling portion of the gland is dislodged with the finger, in some instances there will result interference with the innervation of swallowing; and the consequent difficulty in swallowing may persist for several days. As a result fluids and even solids may enter the respiratory tract, causing paroxysms of coughing and even broncho-pneumonia. A like interference with swallowing may result when the superior thyroid artery escapes and retreats above, just as the inferior artery may retract below. The interference with swallowing is due to the physical injury of the nerves in the catch-as-catch-can process of grasping the vessel. The dissection may be led into this territory without appreciating the risk. Caution and prevention is the only safe method.

*Respiratory Obstruction During Operation.*—With nitrous oxid oxygen apparatus, oxygen under pressure may be at once given in case of tracheal obstruction. We have seen a collapsed trachea dilated at will with a change in pressure by means of the gas-oxygen apparatus. But if for any reason

tracheotomy is needed, a transverse small opening between the rings with a knife should be made early rather than late. Just as soon as the obstruction is removed, the trachea may be closed with a French curved round needle, and the wound closed as usual. If conditions are favorable the wound may be closed.

*Maintenance of a Clear Field.*—For every reason the field should be kept clear from the start to the finish. No division of tissue should be made through blood, especially if scissors are being used. We prefer the knife because the division is more definitive and the chance for error much less.

*Blood in the Trachea.*—If, in an emergency, the trachea be opened the inhalation of blood must be avoided whatever may be the cost in effort and precaution. This is assured by the control of the local field by hæmostats, and by the sheer skill of the first and second assistants. Inhaled blood is very likely to cause death from broncho-pneumonia.

After all these statements regarding the possible sources of error it would seem that a thyroidectomy could not be made satisfactorily; that the possibilities of danger are innumerable, and beset the operator on all sides. But these difficulties cease to be pitfalls the moment the possibility of their occurrence and the manner of their avoidance have been fixed in the mind of the operator and in the minds of his staff. There has been no tracheotomy in our last 1080 operations. By bearing in mind the precautions indicated above we now rarely see any, even the minor, mishaps.

*Delayed Closure.*—In any serious case the wound is left wide open—completely so, the divided muscles and tissues down to the trachea and larynx and the depths of the wound under the clavicle—and the open wound is dressed with 1-5000 flavine gauze. The advantages of this procedure are:

1. It shortens the time of operation. It may cut off the fatal last minute.
2. There is practically no postoperative pain or discomfort, thus it lessens by so much the postoperative drive.
3. *And most important:* leaving the wound open prevents the absorption of wound secretion. Aseptic wound secretion has always been known to cause some postoperative increase in temperature in normal non-sensitized individuals, but in the hypersensitized exophthalmic goiter patients, this reaction may be multiplied many times and become a raging, destroying fever.

These wounds are closed under analgesia and local anæsthesia without removing the patient from bed, as soon as it seems safe, usually in the afternoon of the same day—sometimes the next morning—occasionally on the second day after operation.

As for infection, the wounds closed on the same day run a course almost

## TECHNIC OF OPERATIONS ON THE THYROID GLAND

identical with those in which primary closure has been made. There is a slight tendency after the first six hours to increased contamination.

*When to Stop the Operation.*—If there is any doubt of the outcome at any point, that is the moment to stop the operation, tie off the ligatures and dress the open wound with flavine. Whether mistaken or not, the operation can usually be resumed and completed on the following morning.

*Deception of the Patient.*—Patients are not deceived as to the time of operation. If we have their consent and confidence, we go ahead so carefully, that they are not aware of the day and the hour of operation. But, if a patient demands to know the proposed day and hour, he is told. If, in consequence of this information, his condition becomes unsatisfactory, operation is deferred. This is only an occasional experience. After the strain of one delay, the patient usually is willing to take a passive rôle.

*X-ray Treatment in Thyroidectomy.*—X-ray treatment does reduce the activity of the thyroid. It is a simple, painless procedure. Then why not use X-ray to the exclusion of other procedures? Because of the following disadvantages:

- (a) The dose required to produce a given effect is at best a guess.
- (b) Relapses are common.
- (c) The delay in unsuccessful cases leads to serious damage to certain organs—the myocardium, liver, nervous system, etc.
- (d) In case of operation later, the scar tissue and adhesions caused by the X-ray are a handicap. The dilemma in the use of the X-ray is: Myxedema or relapse. If the dose is sufficient to kill all the thyroid cells, myxedema results; if the dose does not kill the cells, they recover and there is relapse.

*Indications for Ligation.*—In this clinic ligation is employed only as a preliminary to thyroidectomy. Double ligation rarely cures, but as is the case after X-ray treatment, there is a tendency to relapse. And when relapse occurs, we have lost the nicest step in the graded operation.

X-ray might be used instead of ligation as a part of a graded operation, excepting for the uncertainty of the extent to which it has destroyed the thyroid tissue.

*To What is the Good Effect of Ligation Due?*—Certainly not to the diminution of the blood supply, for no matter how soon or how late after ligation the thyroidectomy is performed the local blood supply is found to be diminished but little. In fact, it often seems as if the blood supply after ligation is richer because of all the developed collateral branches. I am of the opinion that the greater part of the benefit from ligation is the result of a break in the nerve supply of the thyroid since the principal sympathetic nerves run in the walls of the superior thyroid arteries.

*What is the Indication for Thyroidectomy? Diagnosis of Hyperthyroidism is the Indication for Thyroidectomy.*—We believe this because if we wait to try out the rest cure, in that case rest fails to cure, and this is true in too

many cases, and when the rest cure fails the patient has sustained serious additional damage, perhaps permanent damage, to the myocardium, to the liver, to the nervous system; his life has been shortened; the difficulty of the operation has been increased; and much time has been lost.

It is only within recent years that we have been able to put hyperthyroidism in the class with appendicitis as to operability, but now the mortality of thyroidectomy is almost as low as the mortality of appendectomy. In view of the comparatively short stay in the hospital, the slight risk, the inconsequential scar, we are prepared to accept the dictum "*operate on diagnosis.*"

## NOTES ON SURGERY OF THE MEDIASTINUM

BY ARNOLD SCHWYZER, M.D.

OF ST. PAUL, MINN.

SURGERY of the mediastinum comes into question in *inflammations*, especially after injury, be it from direct penetrating wounds or from perforations, mostly from the side of the œsophagus. In one such case I found an easy access and good exposure of the *posterior mediastinum* by resecting several ribs near the costovertebral articulation. The pleura could nicely, and without injury, be stripped free. In this way good access was procured. I cannot convince myself that the procedure of Heidenhain is always preferable, where one enters upon the transverse processes of the vertebræ by an incision near the midline and frees the deep musculature of the back toward the side. Heidenhain then removes the transverse processes and the corresponding portions of the ribs. In this manner the danger of injury to the pleura is thought to be more safely avoided. Surely the wound is much deeper and the orientation more difficult. Our case was a septic phlegmonous infection from a foreign body in a child. The operation did not, however, save the patient from the severe sepsis.

*Purulent infections* of the *anterior mediastinum* apart from direct trauma are mostly due to a breaking down of lymph-glands or to the advance of an abscess which started in the neighborhood. Of each of these two conditions I have seen one example.

One was an abscess along the pericardium on the right side. It originated from a tuberculous chondritis of the fourth, fifth and sixth ribs. It had apparently started on the under surface. The abscess formed a narrow cavity of about 4 or 5 cm. depth along the pericardium. As tuberculosis of the rib cartilage never heals, if only the affected portion is removed, the whole of the affected cartilage was thoroughly excised; iodoform was rubbed into the wound; the wound was closed up to a fine silkworm drain and healing occurred promptly.

The second case was a lymph-gland abscess, taking its origin from what seemed to be one of the right peritracheo-bronchial glands. Poirier and Cuneo mention that the glands of this group, the peritracheo-bronchial glands of the right side, are the most frequently affected ones among the peritracheo-bronchial group. The abscess in our case was located behind the second and third cartilages on the right side. After resecting these we entered the abscess cavity, at the depth of which (perhaps 5 or 6 cm. below the surface) a somewhat melanotic but principally chalicotic necrosed lymph-gland of the size of a peeled almond was fished out. The patient was a stone mason, which explained the chalicosis. There was little organic matter left in the gland; it consisted



principally of grayish grit. Healing after a few weeks. The case became doubly interesting when our patient returned about three years later with a similar condition on the other side. This time the abscess pointed in the sternal notch, near the head of the left clavicle; and after incision we could enter an abscess cavity downward and inward behind the manubrium sterni, again about 5 cm. in depth. Again a necrotic mass came out, though only after about a week. It was a necrotic lymph-gland of the anterior mediastinum, belonging to the group which lie in the angle of division of the superior vena cava into the two innominate veins, and which Bartels (Das Lymphgefäßsystem) describes as lymphoglandulæ anguli anonymi. Healing after six or eight weeks.

Apart from purulent infections the mediastinum may be the seat of quite a variety of pathological conditions, in the detection of which the Röntgen rays are by far the most important though not exclusive agent. The most frequent occurrence is a tuberculous enlargement of the hilum glands in connection with pulmonary tuberculosis. It is important to remember that in children such large lymph-gland masses may often be primary, *i.e.*, without pulmonary findings and probably propagated from mesenteric tuberculosis. Occasionally tuberculosis may affect the mediastinum in the form of a cold abscess with its origin in a vertebra or the sternum. Lues in the form of gummata or massive thickening around trachea or bronchi and the large vessels is not very infrequent. History, Wassermann, and lesions in other parts of the body are of course to be taken into the reckoning. Hodgkin's disease and leukæmia can form very large masses in the mediastinum. Compared with other shadows of the same extent they give the least local symptoms, be they circulatory disturbances, tracheostenosis or difficulty at deglutition.

The *thymus* may be enlarged by simple hyperplasia or it may be the seat of neoplasms, though Hoffmann in Nothnagel's "Specielle Pathologie und Therapie" rightly doubts the possibility of definitely recognizing the exact origin in any advanced tumor of this area. Especially the comparatively frequent appearance of lymphosarcomata in the anterior mediastinum is thought to have its origin in the thymus, but may of course have just as well the lymph-glands of this area as matrix.

*Intrathoracic goiters* are among the most frequently seen tumors of the upper mediastinum. They represent a most important and interesting surgical subject, but can only be mentioned in passing.

Aneurisms are another affection of prime importance, particularly those of the different portions of the aorta and of the innominate artery. The Parisian surgeon Guinard reported good results in operation for the aneurism of the truncus anonymus by peripheral ligation, *i.e.*, ligation of the common carotid and the subclavian arteries near the aneurismal sac. I operated on one case in this manner and I may be permitted to report it in short. The patient had been kept flat on his back in bed for six months, and for fear



of rupture he had not even been allowed to sit up for a meal or any other function like defecation. The two arteries were ligated at the same session, and ten days after the operation our patient walked about and could go home. He is now well for over eleven years. The one important point in the operation is to ligate the carotid first and then afterward the subclavian, because embolism occurs easily at the moment of ligation of the first artery, apparently due to the suddenly increased pressure, furthermore to the sudden change in the course of the blood stream and of the whirls in the aneurismatic sac.

As a last chapter, the *neoplasms* remain for discussion. The benign ones are much rarer than the malignant tumors. A few *lipomas* are described; they seem to have started underneath the ribs, and at least two of them, I find, grew outward through an intercostal space, and were thus recognized.

The *chondromata*, a very few in number, started from the chest wall. Only their later course of growth will decide their benign or malignant character.

Of *fibromas* Hoffmann found half a dozen, some of which belong to the older literature and are inexactly reported. I shall describe further on a case of fibroma with partly rather cellular areas. Doctor Bell, Professor of Pathology of the University of Minnesota, considers the tumor however a true fibroma.

Over one hundred *dermoids* have been reported. When still small, they are mostly situated behind the sternum. They develop laterally and grow more and more into the pleural cavity, where they may reach an enormous size, even to fill practically one whole pleural space.

Among the malignant neoplasms we find carcinomata, which take their origin mostly from the œsophagus, at times from carcinoma of the breast or from the trachea or the bronchi. Sarcomas and lymphosarcomas are not so very infrequent. The sarcoma makes large nodular masses, generally prominent on one side of the mediastinum. The X-ray shadow has a rather rounded, sharp outline, which according to Sauerbruch (*Chirurgie der Brustorgane*, 1920) is mainly or exclusively seen on one side of the mediastinal shadow. This is due to a principally expansive growth. The lymphosarcomata, on the other hand, with their exquisitely infiltrating character invade and permeate the neighboring organs rather than simply displace them. The lymphosarcomata form more diffuse neoplastic masses, which show on both sides of the mediastinal shadow. Following the lymph channels they enter along the bronchi into the lung fields, where they produce a marked thickening of the shadow of the hilus with branching along the bronchi like in bronchial carcinoma. This ramification is dense and gives an almost mottled appearance. The malignant tumors of the mediastinum are operable only if unusually favorable circumstances are encountered. Burnham, of Johns Hopkins University (*Jour. Am. Med. Association*, September 22, 1917), writes that, so far as he had been able to ascertain, there had never been a surgical

cure of a malignant mediastinal tumor. I could not go through the whole literature of the subject, but found at least one successful case of a spindle-cell sarcoma reported in the *Beitraege zur klinischen Chirurgie*, 1901, p. 774, operated upon by Marwedel in Czerny's clinic. The tumor was situated behind the sternum and was larger than a man's fist. It formed a sharply outlined mass which could be cleanly removed after resection of the manubrium sterni and of short pieces of the first and second ribs. At the time of the report the patient was well, two years and two months after the operation. Another case of sarcoma by the same operator and reported at the same place, had grown into the mediastinum from its primary seat in the major pectoral muscle. Death one year after the operation.

For the present our only hope in nearly all of these cases lies in the Röntgen rays and more especially in radium. Very large doses of radium with sufficient filtering to remove all but the very hardest gamma rays seem necessary, according to Burnham, who reports most remarkable results. He used only those radium rays which were left after filtering with 3 mm. of lead. If the radium can be introduced into the tumor mass, smaller quantities may be sufficient.

I can report a case in this connection:

On February 21, 1917, a gentleman of twenty-six years consulted me for a mediastinal angiosarcoma. The clinical picture was typical. Our patient was cyanosed. His face was puffed up, the eyes glassy, the veins of the neck distended. Pain in the chest was complained of. A moderate but annoying dry cough existed; pulse 125, temperature  $99^{\circ}/_{10}$ . For many weeks the patient had not been able to sleep in bed or to lie down on account of his dyspnoea. Over the upper part of the sternal region there was a bulging, which was soft to the touch like an angioma. The diameter was about 10 cm. At the periphery you could see tortuous veins. On March 6th, after some X-ray treatment, we gave a few whiffs of ether in sitting posture; tied the peripheral blood-vessels off by interrupted circumferential sutures, made a vertical incision down to the sternum, inserted the radium (50 mg.) into the wound, and immediately packed and compressed. The tendency to bleed was fearful, but compression and some clamps stopped it. The radium was left in only seven hours. Four days later without anæsthetic we made a groove into the manubrium sterni with Luer's gouge bone shears. The bleeding forced us not to go farther. The radium was put into this sternal groove and left in for twenty-three hours. After this the patient felt easier, did not cough as much as before, and began to sleep at night. On March 17th, we went through the sternum and inserted the radium into the retrosternal tumor mass. The tendency to bleed was incomparably less than previously, especially than at the first incision. This time, and one week later, and again after another two weeks, the radium was placed into the wound, each time for about forty-eight hours. In all the patient had 8600 milligram-hours. If we

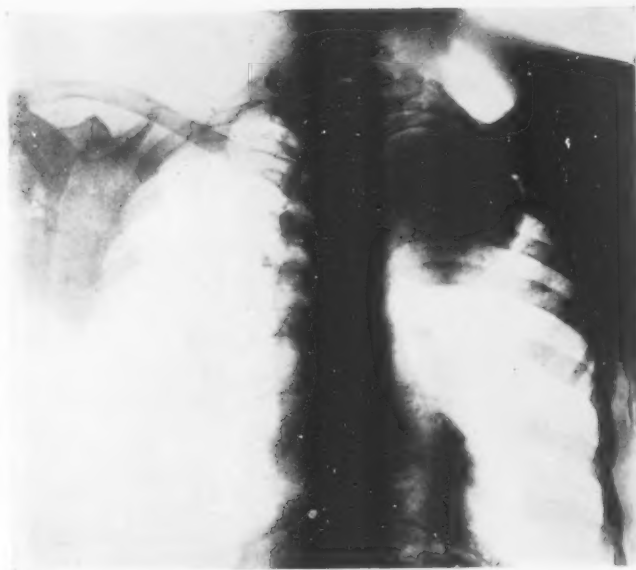


FIG. 1.—Röntgen plate of tumor.



FIG. 3.—Pharyngeal intubation. The nasal and the afferent outer rubber tubes are connected by a sharply bent lead tube to insure freedom and room for operator.

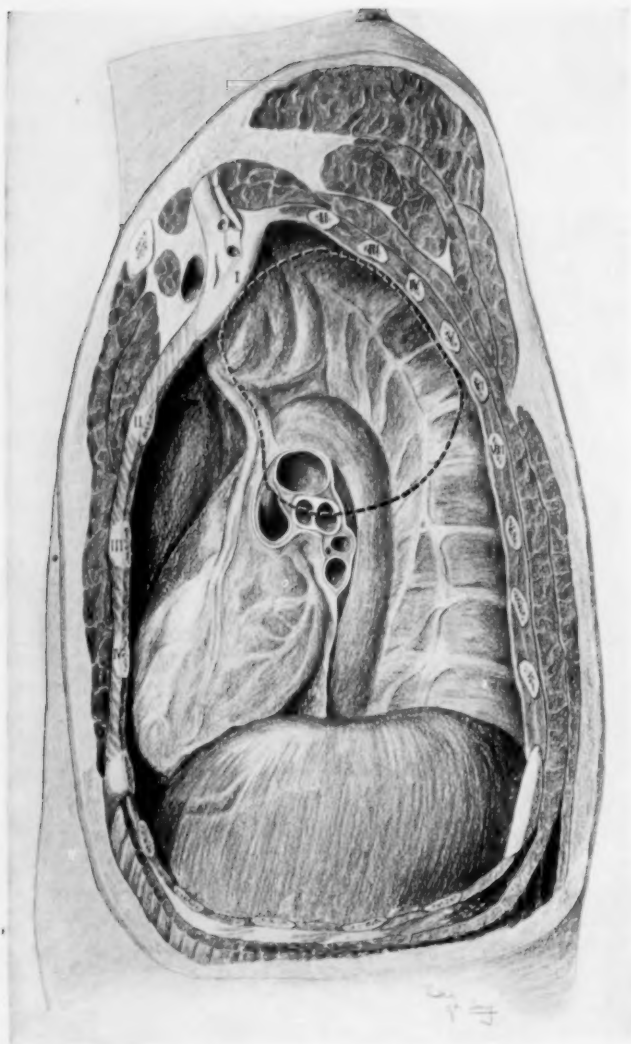


FIG. 2.—Showing location of tumor; dotted outline inserted; plate taken from Corning's Topographic Anatomy.

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consider that this dose was given *in* the tumor, it is a very respectable dose and more than is usually given, for instance, in a carcinoma of the uterus. In addition we gave during that time (including two pre-operative treatments) five X-ray exposures (ten to fifteen minutes, hard tube, with 3 mm. aluminum filter). Pain in the left shoulder was complained of for a while, but the general condition was greatly improved. The patient could sleep in his bed, up to eight hours in the night. He went to the theatre, traveled to his home and came back during the eight weeks he was under our care, and was most enthusiastic. Three months later, I was informed that he succumbed to what was declared a pneumonia.

The principal stimulus for this paper was the following case of fibroma of the upper posterior mediastinum:

A cigarmaker of forty-three years, Russian Jew, was referred to me in December, 1919, for stomach trouble and pain in his chest. His history reads: The beginning of the present trouble dates back nine or ten years. He first noticed stinging pain in the heart area. Four or five years ago vomiting started. It only occurred at times and stopped for two years, to come on again in Spring of 1919. The pain around the heart was the same as ten years before, no worse, not all the time. He can walk well, does not get out of breath. His complaints are really quite moderate, and he had consulted his doctor for the stomach condition only. An X-ray of the chest was made on account of the stinging pain in the left side above the heart, and a tumor was found. The patient declares that since about a year ago his voice is not as strong as it was. It gives out quickly when talking. For certain reasons the patient could not take care of his condition at that time. But after pain had set in in the corresponding region on the dorsal side, and had remained constant for three months, he decided to accept the proposed operation.

The tumor was sharply outlined, did not pulsate, showed no definite growth in the four months he was under observation. By a very competent röntgenologist the mass was declared to be probably a malignant tumor and radium treatment was advised. We could not definitely decide between neoplasm and an intrathoracic struma, though the larynx seemed to move at deglutition. It was thought best to go in and see. If we should encounter an abnormally isolated intrathoracic goiter (a true struma accessoria intra-thoracica) or a well walled-off tumor, this was the only proper course to take. If, on the other hand, we had an inoperable malignant tumor, we could insert the radium into its interior, which would be of decided value.

On April 13, 1920, the operation was performed. A low collar incision was made on the neck. The sternohyoid and sternothyroid muscles were cut. The left sterno-cleido-mastoid muscle is also divided in order to get sufficient room and freedom for action. The thyroid is laid bare and found not to be connected downward. A tumor can be felt in the depth. We first try to get near it directly behind the



sternum, but soon find after recognizing the subclavian and left innominate veins, that access was not to be had, and that further advance would lead to tearing the veins. The lower part of the common carotid is then lifted forward with a retractor. The mass appears so hard, sessile and fixed to the left side of the vertebral column, that removal seems doubtful. Some tortuous veins run across its upper pole.

With the idea of possibly reaching an area of safety and line of cleavage for enucleation, or, in case removal was impossible, an access for the introduction of the radium into the centre of the growth, we bluntly penetrate its most superficial fibrous layer with dissection scissors. The region of the thoracic duct is avoided by keeping to the left of it. Positive pressure respiration, which had been prepared for, is now instituted by the aid of two intranasal tubes. The finger can then enter along the anterior surface of the tumor. After progressing about 6 cm. down on the tumor, the finger makes a rent in the pleura. Under the differential pressure the lung is sufficiently ballooned, that we can feel its soft, gently moving, free border. It becomes necessary to get more room. A vertical incision over the sternum enlarges the wound downward. With a finger inserted directly behind the sternum for the protection of the innominate vein a narrow segment of bone is removed with gouge bone shears from the middle of the sternal notch down to the upper border of the second rib. With a sharp bone hook in the head of the clavicle the gap in the sternum can be spread to 3 cm., and the parts are better accessible. After introducing two fingers with considerable force and making use of the cleft in the sternum, the lower pole is felt to be free, while the principal fixation of the tumor is found to be at its upper posterior side. A couple of artery forceps, with one branch inserted into the tumor, give a good hold on it. The fibrous outer layers of the mass are cut between the clamps. The interior proves to be yellowish, broken-down material, partly fluid and partly solid tissue. By crawling down on the tumor alternately with the two forceps and cutting between them the tumor is forced out. A promptly inserted large gauze packing stops the bleeding. Then, in order to obtain a hermetic closure of the pleural space, the cleft in the sternum is covered by a suture of the subcutaneous tissues, and the lower halves of the divided sternohyoid and sternothyroid muscles of the two sides are united in the midline. To make this suture air tight, the lower half of the divided left sternomastoid is dissected free toward its lower attachment and fastened across. The skin is closed up to three small superficial drains. The pulse was good all through the operation, and is 70 at its termination. On the day after the operation a dullness was found over the left side from the angulus speculæ down. This was probably blood and serum. It was left alone. Over the upper portions of the lung nice vesicular breathing could be heard. Recovery was prompt; the exudate cleared away rapidly, and sixteen days after the operation the patient went home. An X-ray picture taken on October 20th gives clear lung fields.\*

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\* X-ray examination in August, 1921 showed again entirely clear lung fields.



## SURGERY OF THE MEDIASTINUM

As to differential pressure, it can be said that it was not only helpful in procuring good and easy breathing, but that it was valuable in letting us recognize the amount of the bleeding. With a ballooned lung, which fills the pleural space, the blood shows better in the wound and keeps us informed of the bleeding at every moment and by every move. Not only is overpressure useful for these mentioned reasons, but it becomes indispensable and of prime importance when the possibility of injury to both pleural cavities exists as in operations directly behind the sternum.

Our apparatus was the simplest possible, and for that reason was not likely to fail us in functioning. A Ben Morgan ether chamber, which happened to be the readiest simple outfit at hand, was connected with a good large bellows. We might have used the nitrous oxide and oxygen bombs,

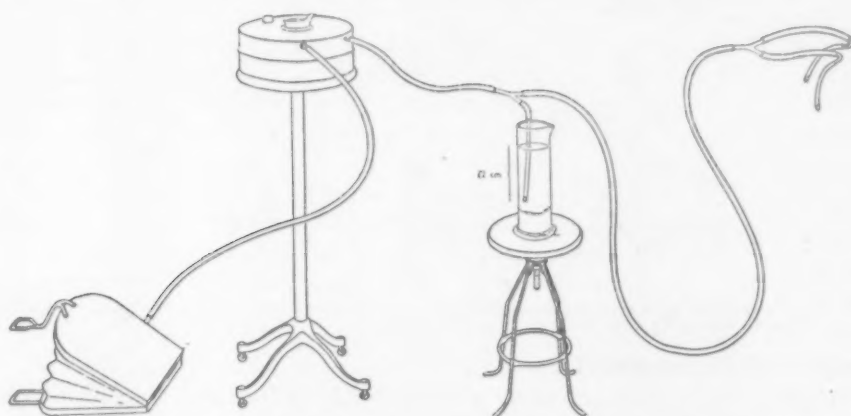


FIG. 4.—Overpressure apparatus for intranasal pharyngeal intubation, improvised with bellows and a Ben Morgan apparatus. The glass tube, which is immersed in water, acts as manometer and safety valve.

and they were in fact on hand, but the bellows would not fail us and would not give out as a bomb will, and no disturbance and interruption by changing of bombs would have to be figured with. The ether chamber was connected by a long, good-sized rubber tube with two intranasal tubes, which are to be inserted down to—but not beyond—the soft palate. Their openings, which are cut off on a slant, are to barely show behind the velum. Between the ether chamber and the intranasal tubes, which are connected by means of a forked glass tube, the long rubber tube is tapped by a T-shaped glass piece. The third arm of it is connected with a straight glass tube, about a foot long, which reaches into a high glass vessel filled with water. This serves as manometer and as safety valve. The glass tube was so fastened in our case, that it entered 22 or 23 cm. below the level of the water. This gave us approximately 17 mm. of mercury pressure, a pressure somewhat too high if the mouth is kept closed tight. An assistant was instructed to work the bellows just enough to produce a gentle bubbling in the water manometer, which assured the proper pressure and let the operator hear that everything

worked well. The anæsthetist could regulate the pressure by closing the patient's mouth more or less firmly with gauze. For obtaining a gentler and more evenly sustained pressure we had formerly prepared a wide connection with a soft rubber balloon of large size, which ought to be close to the patient. As so often happens with rubber goods, the balloon, having long laid idle, was spoiled. We got along well without it, though in a long operation it would be desirable. Instead of the intranasal tubes one could use a well-fitting face mask; but the pressure would not be so even and safe. The ether chamber is not an essential. Its place can be taken by some balloon or tank like container, which steadies the pressure procured by the interrupted action of the bellows. The main tube is then tapped near the patient (as I had arranged it at a previous occasion) by a smaller tube entering from the side, through which ether vapors are pumped in according



FIG. 5.—Overpressure apparatus for intranasal pharyngeal intubation, improvised with bellows, a large rubber bag and a small rubber bulb pump from a Paquelin cautery for the addition of ether vapors.

to need by the anæsthetist.

If we do not want to introduce a stomach tube beforehand, the epigastrium needs watching for possible distention of the stomach.

What I am particularly anxious to illustrate is the point that some sort of overpressure can readily be improvised. For the occasional operator in this field it is much more important to be ready to improvise some apparatus, even if primitive, than to own a cumbersome outfit, which is stored away somewhere and may be out of order when needed. The difference in results between no apparatus and a primitive one is a good deal larger than between a primitive and an elaborate one.

In our case the differential pressure was not used long enough to produce the otherwise much dreaded shock. The narcosis was quite smooth, as is the rule in overpressure narcosis. Closure of the glottis does not occur or is at least counteracted. Vomiting is practically never seen. I can fully agree with Sauerbruch, that local anæsthesia (in its present form of development) in intrapleural operations is a capital mistake, because "forced and excited breathing, stoppage of respiration and abnormally deep aspiration with all its disturbances and shock" are then very marked.

LIFE EXPECTANCY FOLLOWING RADICAL AMPUTATION  
FOR CARCINOMA OF THE BREAST: A CLINICAL AND  
PATHOLOGIC STUDY OF 218 CASES\*

BY WALTER E. SISTRUNK, M.D.

OF THE SECTION ON SURGERY

AND

WILLIAM C. MACCARTY, M.D.

OF THE SECTION ON SURGICAL PATHOLOGY, OF THE MAYO CLINIC,

ROCHESTER, MINN.

THE study of these cases was undertaken for the purpose of determining, as nearly as possible, the life expectancy of patients on whom primary radical amputations of the breast have been performed for carcinoma. The factors which seem important in determining the expectancy of life were carefully studied from a clinical and a pathologic standpoint in a series of 218 patients with carcinoma of the breast operated on in the Mayo Clinic. The conclusions reached from the clinical findings and the findings at operation are discussed first, the microscopic picture of the tumors removed and the bearing which these different pictures seem to have on the prognosis are next considered.

It is impossible to foretell the duration of life of all patients with carcinoma of the breast, because the degree of malignancy varies widely, and persons react differently to the disease. For instance, certain types of carcinoma of the breast cause death within a few months after they are recognized, and other types metastasize slowly and do not prove fatal for many years; the latter, however, are rare and constitute only a small percentage of carcinomas of the breast. In the majority of these it is possible to make a fairly accurate prognosis with regard to the duration of life following operation.

It was gratifying to find, from our statistics, that the results obtained from early operations for carcinoma of the breast are probably better than those obtained in operating for any other type of malignant growths, with the exception of basal-cell epitheliomas and epitheliomas of the lip. Patients who apply for treatment may be classed in three groups:

*Group 1.*—Patients with inoperable growths; growths firmly fixed to the chest-wall; extensive ulcerating growths with metastatic skin nodules; fixed masses in the axilla; extensive involvement of the axillary and supraclavicular glands, or internal metastasis. Operation is of no avail and is probably harmful.

*Group 2.*—Patients who have removable growths, but in whom, because of the extent of the growth, or the glandular involvement, a cure cannot be expected by operation. Operation is often performed from an humanitarian

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standpoint, without expectation of cure, to relieve future suffering and discomfort.

*Group 3.*—Patients with removable growths, with or without metastasis in the axillary glands. These patients have a chance for cure through operation. It is the prognosis in this group that we wish to discuss.

By studying the results obtained in 218 cases we found that 51.8 per cent. of the patients operated on, one of each two patients, were living three years after operation. Seventy-five and six-tenths per cent. of the patients without glandular involvement, three of each four patients, were living at the end of three years, and 36.6 per cent. of the patients with glandular involvement, about one of each three patients, were alive at the end of three years. (Table I.)

Thirty-nine per cent. of the patients, about two of each five patients, were alive at the end of five years. Sixty-five and one-tenth per cent. of the patients without glandular involvement, about six of each ten patients, were alive at the end of five years, and 21.9 per cent. of the patients with glandular involvement, about one of each five patients, were alive at the end of five years.

Thirty-six and seven-tenths per cent. of the patients, about one of each three patients, 63.9 per cent. of the patients without glandular involvement, about six of each ten patients, and 18.9 per cent. of the patients with glandular involvement, about one of each five patients, were living from five to eight years after operation.

Of the series of 218 patients, 2.7 per cent. died within six months; 21.1 per cent. died within one year; 34.9 per cent. died within two years; 42.2 per cent. died within three years; 49.1 per cent. died within four years, and 55 per cent. died within five years. Only 2.3 per cent. died after five years. Four and one-tenth per cent. of the patients living from five to eight years after operation have recurrences, and it is probable that these will die from cancer. After eight years the disease rarely recurs.

Carcinomas which developed during pregnancy and during the lactating period invariably proved fatal within five years after operation. Diffuse carcinomas which involved practically the entire breast caused death in every instance within five years; all but one of the sixteen patients with this type of growth died within three years after operation. When the axillary glands were involved, carcinomas around the nipple proved fatal in seventeen of eighteen patients (94.5 per cent.) within five years. Seventeen of twenty patients with ulcerating carcinomas (85 per cent.) were dead at the end of seven years; fourteen died within five years after operation.

Age seems to have a definite bearing on the results to be expected following operation. Forty-one and seven-tenths per cent. of the patients over fifty are alive from five to eight years after operation, while only 31.8 per cent. of those under fifty have lived a corresponding time. The immediate hospital mortality was less than 0.5 per cent.

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In our experience the prognosis has not been affected by the complete removal of small growths for microscopic diagnosis before the radical operation is performed. When local recurrences were found following operation, metastasis was demonstrated in other regions in 60.9 per cent. of the cases, or in six of each ten patients. Nearly all patients who had recurrences following operation died from the disease.

## RESULTS OBTAINED IN 218 CASES IN WHICH OPERATION WAS PERFORMED

Of eighty-six patients (39.5 per cent.) without glandular involvement, fifty-five (63.9 per cent.) are alive from five to eight years after operation. Six of the patients had recurrences. Thirty-one (36.1 per cent.) are dead.

Of 132 patients (60.5 per cent.) with glandular involvement twenty-five (18.9 per cent.) are alive from five to eight years after operation; three had recurrences, and 107 (81.1 per cent.) are dead.

TABLE I  
*Three, Five, and Eight Year Cures (218 Cases) \**

Decades.	Pa- tients.	Alive three years after operation.	Alive five years after operation.	Alive from five to eight years after operation.
20 to 30 With glandular involvement ..	3	0	0	0
Without glandular involvement ..	1	1	1	1
30 to 40 With glandular involvement ..	16	4	1	1
Without glandular involvement ..	15	11	9	9
40 to 50 With glandular involvement ..	50	17	10	8
Without glandular involvement ..	25	20	16	16
50 to 60 With glandular involvement ..	28	10	8	8
Without glandular involvement ..	31	24	22	22
60 to 70 With glandular involvement ..	26	12	8	6
Without glandular involvement ..	11	7	6	5
70 to 80 With glandular involvement ..	9	5	2	2
Without glandular involvement ..	3	2	2	2
		113(51.8%)	85(39%)	80(36.7%)
Total... With glandular involvement ..	132	48(36.6%)	29(21.9%)	25(18.9%)
Without glandular involvement ..	86	65(75.6%)	56(65.1%)	55(63.9%)

\* In thirteen cases the exact date of death was unknown.

## PERCENTAGE OF DEATHS OF PATIENTS UNDER AND OVER FIFTY, WITH AND WITHOUT GLANDULAR INVOLVEMENT

One hundred ten (50.5 per cent.) of the patients operated on were under fifty; sixty-nine (62.7 per cent.) had glandular involvement, and nine (13.0 per cent.) are alive from five to eight years after operation. Forty-one (37.3 per cent.) were without glandular involvement, and twenty-six (63.4 per cent.) are alive from five to eight years after operation.

One hundred eight (49.5 per cent.) were over fifty; sixty-three (58.3 per cent.) had glandular involvement, and sixteen (25.4 per cent.) are alive from five to eight years after operation. Forty-five (41.7 per cent.) were without glandular involvement and twenty-nine (64.4 per cent.) are alive from five to eight years after operation.



## PATHOLOGIC FACTORS IN THE LONGEVITY IN CANCER OF THE BREAST

One of the most important questions involved in the entire subject of cancer is: Why do some patients live longer than others with grossly the same or even less local or general cancer? This question was emphasized in the study of a series of cases of gastric cancer,<sup>1</sup> in which it was found that patients with complete involvement of regional lymphatic glands often lived much longer than patients without regional glandular involvement, although as a general rule postoperative longevity is in inverse relation to the amount of glandular involvement. In one series of gastric cancers it was observed that two factors, cellular differentiation and lymphocytic infiltration, apparently play a part in the defensive mechanism against new growths. Thus patients without glandular involvement and with local lymphocytic infiltration lived, on an average, 124 per cent. longer postoperatively than patients without glandular involvement and without local lymphocytic infiltration, and patients with glandular and with local lymphocytic infiltration lived 146 per cent. longer than patients with glandular involvement without lymphocytic infiltration. The average length of postoperative life was increased 7.5 per cent. in the presence of cellular differentiation. When differentiation and lymphocytic infiltration were both present the average length of postoperative life was increased 82 per cent. These data represent averages and do not apply to all specific cases. As general facts, they give some clue to the defensive mechanism of the body against malignant neoplasms.

In the series of 218 cases of mammary cancer here reported it was found that death had occurred in 138. In ninety-one\* of these cases complete pathologic material was preserved and studied in detail from the standpoints of cellular differentiation, lymphocytic reaction, fibrosis, and hyalinization (Tables II, III, IV, and V); the two latter possible defensive factors are in greater evidence in mammary cancer than in gastric cancer.

It will be remembered that neoplasia in the breast manifests itself in three reactions—primary, secondary, and tertiary cytoplasia,<sup>2, 3</sup>—and that these stages are found with or without the presence of partial cellular differentiation, lymphocytic reaction, fibrosis, and hyalinization, the last three of which, we believe, represent either etiologic factors or a defensive mechanism. The conception that the presence of cellular differentiation is unfavorable to the continued growth of cancer cells is based on the unwritten law in general biology that power of cellular reproduction is inversely proportional to cellular differentiation. If this law is correct, cancer cells which show partial differentiation, as in 15 per cent. of the cases of mammary cancer studied, must of necessity grow less rapidly than cancer cells without differentiation.

The following generalizations may be made from the data studied con-

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\* All pathologic specimens were studied independently of any knowledge of the clinical histories or postoperative mortality. It was not until the pathologic observations were made and recorded that they were assembled with the preoperative and postoperative histories.



# LIFE EXPECTANCY BREAST OPERATIONS

TABLE II  
Patients without Glandular Involvement at Operation who died

	Postoperative Life											
	Decades			Patients			Total					
	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80	80 to 90	90 to 100	100 to 110	110 to 120	120 to 130	130 to 140	140 to 150
	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days
Longest.....	4	5	2	5	5	16	4	5	0	5	5	16
Shortest.....	3	0	22	1	2	14	1	1	16	3	1	16
Average.....	3	5	19	3	4	9	2	3	11	2	6	17
Average with local lymphocytic infiltration alone.....	3	5	19	2	1	17	1	1	11	2	1	17
Average with local lymphocytic infiltration, hyalinization and fibrosis.....	3	5	19	1	3	2	1	1	16	3	3	23
Average without local lymphocytic infiltration, hyalinization and fibrosis.....	3	5	19	3	5	16	1	1	16	2	5	19
Average with cellular differentiation.....	3	5	19	3	5	16	1	1	16	2	5	19
Average without cellular differentiation.....	3	5	19	3	5	16	1	1	16	2	5	19
Average with local fibrosis.....	3	5	19	3	5	16	1	1	16	2	5	19
Average without local fibrosis.....	3	5	19	3	5	16	1	1	16	2	5	19
Average with local lymphocytic infiltration.....	3	5	19	3	5	16	1	1	16	2	5	19
Average without local lymphocytic infiltration.....	3	5	19	3	5	16	1	1	16	2	5	19
Average with local lymphocytic infiltration and fibrosis.....	3	5	19	3	5	16	1	1	16	2	5	19
Average without local lymphocytic infiltration and fibrosis.....	3	5	19	3	5	16	1	1	16	2	5	19
Average with local lymphocytic infiltration and hyalinization.....	3	5	19	3	5	16	1	1	16	2	5	19
Average without local lymphocytic infiltration and hyalinization.....	3	5	19	3	5	16	1	1	16	2	5	19
Average with local hyalinization.....	3	5	19	3	5	16	1	1	16	2	5	19
Average without local hyalinization.....	3	5	19	3	5	16	1	1	16	2	5	19

TABLE III  
Patients with Glandular Involvement at Operation who died

	20-30	30-40	40-50	50-60	60-70	70-80	Total
	Decades						
	Cases.						
Without cellular differentiation.....	3(100%)	9(90%)	28(90%)	12(92%)	14(100%)	2(66.66%)	68(91%)
Without local lymphocytic infiltration.....	1(33.33%)	2(20%)	10(32%)	4(30%)	7(50%)	1(33.33%)	25(33%)
Without local hyalinization.....	2(66.66%)	6(60%)	17(54%)	5(37%)	6(42%)	0	36(48%)
Without local fibrosis.....	2(66.66%)	3(30%)	9(29%)	3(23%)	6(42%)	0	23(31%)
With local lymphocytic infiltration and local fibrosis.....	1(33.33%)	6(60%)	14(45%)	7(53%)	3(21%)	2(66.66%)	33(44%)
With local lymphocytic infiltration and local hyalinization.....	1(33.33%)	4(40%)	8(25%)	5(37%)	2(14%)	2(66.66%)	22(29%)
With local hyalinization and fibrosis.....	1(33.33%)	4(40%)	14(45%)	8(60%)	7(50%)	3(100%)	37(50%)
With local lymphocytic infiltration, hyalinization and fibrosis.....	1(33.33%)	4(40%)	8(25%)	5(37%)	2(14%)	2(66.66%)	22(29%)
<i>Patients who Died and who were without Glandular Involvement at the time of Operation</i>							
Without cellular differentiation.....	2(100%)	5(100%)	0	2(66.66%)			9(52%)
Without local lymphocytic infiltration.....	0	2(40%)	6(85%)	2(66.66%)			10(58%)
Without local hyalinization.....	0	2(40%)	3(42%)	1(33.33%)			6(35%)
Without local fibrosis.....	0	2(40%)	2(28%)	0			4(23%)
With local lymphocytic infiltration and local fibrosis.....	2(100%)	1(20%)	1(14%)	1(33.33%)			5(29%)
With local lymphocytic infiltration and local hyalinization.....	2(100%)	1(20%)	1(14%)	0			4(23%)
With local hyalinization and fibrosis.....	2(100%)	3(60%)	4(56%)	2(66.66%)			11(64%)
With local lymphocytic infiltration, hyalinization, and fibrosis.....	2(100%)	1(20%)	1(14%)	0			4(23%)
<i>Total Number of Patients Dead</i>							
Without cellular differentiation.....							77(84%)
Without local lymphocytic infiltration.....							35(38%)
Without local hyalinization.....							42(46%)
Without local fibrosis.....							27(29%)
With local lymphocytic infiltration and local fibrosis.....							38(41%)
With local lymphocytic infiltration and local hyalinization.....							26(28%)
With local hyalinization and fibrosis.....							48(52%)
With local lymphocytic infiltration, hyalinization, and fibrosis.....							26(28%)

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TABLE IV  
Patients with Glondular Involvement at Operations who died

	Decades												Total																																																																						
	20 to 30			30 to 40			40 to 50			50 to 60				60 to 70			70 to 80																																																																		
	Patients																																																																																		
3												10												31												13												14												3												74											
												Postoperative life																																																																							
	Years			Months			Days			Years			Months			Days			Years			Months			Days			Years			Months			Days			Years			Months			Days																																								
	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days	Years	Months	Days																																															
Longest	3	1	10	4	9	3	7	0	3	5	0	1	1	3	3	12	1	3	25	2	8	5	1	5	11	0	3	3	7	0	3	3	3	3	3	3																																															
Shortest	1	7	0	0	5	2	1	5	11	0	4	14	27	3	10	17	2	4	25	2	4	8	1	3	15	18	1	5	17	4	11	5	15	12	11																																																
Average	0	7	21	2	3	16	2	4	15	5	13	5	2	2	4	9	2	3	10	2	4	8	3	7	3	0	3	5	1	5	1	6	15	12	11																																																
Average with local lymphocytic infiltration	1	6	21	1	7	11	1	5	8	1	4	12	27	2	14	17	2	4	25	2	4	8	3	7	3	0	3	5	1	5	1	6	15	12	11																																																
Average with local lymphocytic infiltration, hyalinization, and fibrosis	3	1	0																																																																																
Average without local lymphocytic infiltration, hyalinization, and fibrosis	1	0	4	1	5	4	3	3	17	2	3	12	1	3	25	2	8	5	1	5	11	0	3	3	7	0	3	3	3	3	3	3	3	3	3																																																
Average with cellular differentiation	1	7	0	1	5	2	1	5	11	0	4	14	27	3	10	17	2	4	25	2	4	8	1	3	15	18	1	5	17	4	11	5	15	12	11																																																
Average without cellular differentiation				3	0	0	3	5	20	4	4	12	27	2	14	17	2	4	25	2	4	8	3	7	3	0	3	5	1	5	1	6	15	12	11																																																
Average with local fibrosis	1	6	21	1	7	11	1	5	8	1	4	12	27	2	14	17	2	4	25	2	4	8	3	7	3	0	3	5	1	5	1	6	15	12	11																																																
Average without local fibrosis	1	0	4	1	10	3	2	4	10	1	1	12	6	2	15	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average with local lymphocytic infiltration	1	7	0	1	7	3	2	4	10	1	1	12	6	2	15	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average without local lymphocytic infiltration	2	0	17	2	5	8	2	4	16	1	4	13	1	3	21	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average with local lymphocytic infiltration and fibrosis	1	0	7	1	7	10	2	4	12	1	4	13	1	3	21	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average without local lymphocytic infiltration and fibrosis	1	7	0	1	5	14	2	3	14	1	2	13	1	3	29	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average with local lymphocytic infiltration and hyalinization	1	0	4	1	9	16	3	3	17	2	3	14	1	3	25	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average without local lymphocytic infiltration and hyalinization	1	7	0	1	9	16	5	5	16	2	3	14	1	3	25	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average with hyalinization	1	7	0	1	9	16	2	5	11	2	3	14	1	3	25	2	8	5	1	5	11	0	3	3	7	0	3	5	1	5	1	6	15	12	11																																																
Average without hyalinization	1	7	0	1	9	16	2	5	12	1	2	1	1	2	1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2																																																

cerning ninety-one patients who died in the series of 218 patients with mammary cancers:

1. Cellular differentiation occurred in 8.6 per cent.
2. Local lymphocytic infiltration occurred in 62 per cent.
3. Local hyalinization occurred in 54 per cent.
4. Local fibrosis occurred in 71 per cent.
5. Lymphocytic infiltration and fibrosis occurred in 41 per cent.
6. Lymphocytic infiltration and hyalinization occurred in 28 per cent.
7. Hyalinization and fibrosis occurred in 52 per cent.
8. Lymphocytic infiltration, hyalinization, and fibrosis occurred in 28 per cent.
9. The average length of postoperative life of patients with local lymphocytic infiltration alone was 28 per cent. greater than the average length of postoperative life of the ninety-one patients.
10. The average length of postoperative life of patients without local lymphocytic infiltration was 15 per cent. less than the average length of postoperative life of patients with local lymphocytic infiltration.

TABLE V  
*Postoperative Life of Patients Dead (Ninety-one)*

	Years	Months	Days
Longest .....	7	0	3
Shortest .....	0	3	5
Average .....	1	8	24
Average with local lymphocytic infiltration alone .....	2	2	16
Average with local lymphocytic infiltration, hyalinization, and fibrosis .....	2	4	17
Average without local lymphocytic infiltration, hyalinization, and fibrosis .....	1	4	17
Average with cellular differentiation .....	2	8	18
Average without cellular differentiation .....	1	8	22
Average with local fibrosis .....	1	10	13
Average without local fibrosis .....	1	3	20
Average with local lymphocytic infiltration .....	1	7	22
Average without local lymphocytic infiltration .....	1	10	20
Average with local lymphocytic infiltration and fibrosis .....	1	8	23
Average without local lymphocytic infiltration and fibrosis .....	1	8	21
Average with local lymphocytic infiltration and hyalinization .....	2	4	19
Average without local lymphocytic infiltration and hyalinization .....	1	8	20
Average with local hyalinization .....	1	10	14
Average without local hyalinization .....	1	6	21

11. The average length of postoperative life of the patients with lymphocytic infiltration, hyalinization, and fibrosis was 37.8 per cent. greater than the average length of postoperative life of the ninety-one patients as a group.

12. The average length of postoperative life of patients without lymphocytic infiltration, hyalinization, and fibrosis was 42 per cent. less than the average length of postoperative life of patients with lymphocytic infiltration, hyalinization, and fibrosis.

13. The average length of postoperative life of the patients with cellular

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differentiation was 57 per cent. greater than the average length of postoperative life of the ninety-one patients.

14. The average length of postoperative life of patients with fibrosis was 7 per cent. greater than the average length of postoperative life of the ninety-one patients, and 42 per cent. greater than that of the patients without fibrosis.

15. The average length of postoperative life of patients with lymphocytic infiltration and hyalinization was 44 per cent. greater than the average length of postoperative life of the ninety-one patients.

16. The average length of postoperative life of patients with fibrosis and hyalinization was 1.48 per cent. greater than the average length of postoperative life of the ninety-one patients, and 4.87 per cent. greater than the average length of postoperative life of patients without fibrosis and hyalinization.

### CONCLUSIONS

1. The three greatest single factors in increased postoperative longevity of the ninety-one patients with mammary cancers are cellular differentiation, hyalinization, and fibrosis.

2. Lymphocytic infiltration alone does not appear to be the main factor.

3. It appears that while hyalinization and fibrosis play, individually, some part in increasing longevity in cases of cancer of the breast the two greatest known combined factors are cellular differentiation and hyalinization.

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## THE TRANSVERSE ABDOMINAL INCISION

BY WILLIAM J. MOORE, L. R. C. S. E.

OF GLASGOW, SCOTLAND

ASSISTANT SURGEON, ROYAL SAMARITAN HOSPITAL

WITH the exception of colostomy and gastrostomy, all intra-abdominal operative procedures are of comparatively recent date; but, in spite of that fact, the literature on abdominal surgery is probably more voluminous than in any other branch of surgery.

From the "anæsthesia" point of view, the work of Simpson and Morton made major surgery possible; but it remained for Lister to make the surgery of the body cavities not only possible but safe.

One of the greatest living surgeons and pioneer of abdominal work said that it was almost criminal to cut any of the muscles of the abdominal wall; and therefore all abdominal incisions were planned so that they ran in the plane of the muscle fibres, allowing of their separation, and so that the interior of the abdomen, with its contents, could be explored. This was held, by the majority of the surgeons, as an accepted fact for many a long day; and it remained for Maylard to give us the transverse incision, which, in many instances, has rendered intra-abdominal manipulations, which were previously regarded as some of the most difficult, the easiest operations in surgery.

The history of the evolution of the transverse incision is interesting. It is not certain as to who was the first to practice the transverse incision of the abdominal wall; Bardenheuer is given the credit by some.

In 1896, Kustener made a transverse incision of the skin for the performance of a certain gynæcological operation, and at the time, but unknown to Kustener, Rafain, another gynæcologist, had elaborated the same technic.

In 1900, Stimson reports having made use of a combined longitudinal and transverse abdominal incision; and, also in 1900, Pfannenstiel independently introduced a transverse incision through skin and fascia, in gynæcological work, which he called the suprasymphyseal transverse fascial incision.

Naudet, working in the clinic of Professor Hartmann, of Paris, published results of the use of a transverse incision through skin and fascia.

But the real transverse incision through the complete thickness of the abdominal parietes, and in any part of the abdominal wall, was introduced by Maylard, of Glasgow, in 1898.

The history of what led to Maylard's introduction of this technic begins with the observations made by him, in his treatment of a gastric case. He had operated upon a man's stomach by the ordinary median longitudinal supra-umbilical incision; but, a few days later, it was found to be necessary to reopen the abdomen, and in view of what was found, more room for the performance of the intra-abdominal operations was found to be necessary; the



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right rectus abdominis was therefore cut across. As a result, it was found that the union of the transverse part of the incision was excellent, but a post-operative ventral hernia developed in the longitudinal part of the scar.

After this result, and following upon the observations made in a comparison between the longitudinal and the transverse incisions, Maylard, a few years later, came ultimately to adopt the "transverse incision" of the abdominal wall, as a routine method for all intra-abdominal operations.

Moschcowitz, in the *ANNALS OF SURGERY*, September, 1916, part 265, says that at the date of writing the paper he had examined all his cases, and had not found one single case of ventral hernia. It is to be noted that Moschcowitz did not make his first transverse incision until August 2, 1910, or twelve years later than Maylard.

In the *ANNALS OF SURGERY*, February, 1918, part 302, J. W. Churchman describes a new incision for exploration of the lower abdomen; this incision is in the form of a Y, but according to the author is not applicable generally, but only to the pelvic branch of abdominal surgery.

After this brief résumé of the history of the transverse incision, I will now deal with the subject under various headings.

### ESSENTIALS OF AN ABDOMINAL INCISION

1. It should be so planned that the maximum amount of intra-abdominal freedom is obtained, with the minimum amount of damage to nerves and muscular tissue.
2. The incision should be in such a position, and of such dimensions, that the use of retractors is reduced to a minimum.
3. It should be such that complete temporary muscular relaxation is obtained, because then retraction becomes unnecessary, and shock will be less, since the stimulus necessary for the production of the abdomino-visceral reflex, the connecting link between the abdominal wall and the intra-abdominal organs, is absent.
4. The shock should be as little as possible, with therefore less liability to primary and reactionary hemorrhage.
5. The margins of the incision should tend to fall together.
6. It should be capable of closure, without strain being put upon the constituent parts of its margin.
7. When suturing is complete the margins should be in such a position that the various tissue elements are placed directly opposite each other, so that any exertion on the part of the patient tends to bring them closer together and not further apart.
8. The amount of scar tissue produced should be as small in quantity as possible, and so placed that while it acts as a connection between the severed ends of the various tissues, it should have at no time any mechanical or supporting function required of it.
9. The amount of severance of, or injury to, nerves should be as little as

possible, so that the abdomino-visceral arcs be left proportionately intact, with little resulting muscular paralysis.

*Anatomically*, the abdominal wall is composed chiefly of several layers of long, flat muscles—three laterally and two median. These, together with the skin, fascia, subperitoneal tissue, and the peritoneum, form the abdominal wall.

There is nothing peculiar in regard to the muscles forming the abdominal wall, but the recti and their respective sheaths. These muscles are peculiar, in that they are formed of two distinct sets of fibres; one set forming, approximately, one-third of the total mass of muscle, which stretches without interruption from its origin to insertion and therefore its actions are, as far as that portion of the muscle is concerned, between these two points; the remaining two-thirds of the muscle, however, show three, sometimes four, fibrous intersections—the lineæ transversæ. These lineæ transversæ are firm fibrous bands, intimately associated with and adherent to the posterior surface of the anterior wall of the sheath of the rectus abdominis. Their function is most probably to provide intermediate points for force and resistance to allow of the recti performing what is called segmental action. By this means it is possible to increase or diminish the abdominal tensions, in any or all of the upper, middle, or lower divisions of the abdomen. This has a very important bearing upon the transverse incision of the rectus and its sheath, and the other abdominal muscles, because the result of such an incision is simply the formation of another linea transversa.

The mode of formation of the rectus sheath is well known, and it is well to remember that its contents are the superior and deep epigastric vessels, with their branches and tributaries, so that to secure efficient hæmostasis, two sets of ligatures, one pair on each side, will be at least required.

Accepting the fact that, when the nerve supply to any muscle is damaged or destroyed, that muscle atrophies to a greater or lesser extent, it is most important that all abdominal operations that require interference with muscles should have their incision so planned, that there will be the least possible interference with the nerve supply of those muscles.

The nerve supply of the abdominal muscles is derived from the seventh, eighth, ninth, tenth and eleventh intercostal nerves, the subcostal nerve, the inguinal, and the hypogastric branches of the ilio-hypogastric nerve.

The course of these nerves, from their origin to their distribution, is such that, while not transverse, it is only very slightly oblique. They run forward and inward, between the muscle planes, and perforate the posterior wall of the sheath of the rectus at its outer border, and then the anterior wall of the rectal sheath, in its outer part, prior to becoming cutaneous.

It is thus seen that from an anatomical point of view any incision made vertically, and parallel to the middle line of the body, must, according to its length, cut one or more of these nerves completely; the amount of nerve injury involved in the longitudinal incision is great; with the transverse incision the risk of damaging to any great extent the nerves supplying the musculature

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of the abdominal wall is small; the incision is running practically with them in their course, and for that reason the incision is anatomically correct.

*Physiologically*, the action of the abdominal muscle is well known, and does not merit further discussion, except in that it is more than probable that its function of maintaining the abdominal contents in position is much overestimated.

It is, and has been, held that if a muscle of the abdominal wall is injured or cut a ventral hernia will be produced; such in many instances is not the case. Every now and again one sees, after a longitudinal incision has been made in the sheath of the rectus muscle, and the patient unexpectedly strains, that the rectus bulges into the wound, showing how little real power it possesses of maintaining the contour of the abdominal wall, or of retaining the intra-abdominal contents in their various positions.

Now and again, while working through a longitudinal incision, and should the patient be allowed to come partially out of the anæsthetic, it is noticed that the muscles tend to separate and not to come together; with the result that the opening in the abdominal wall is markedly enlarged, and the intestines are protruded. If, however, the incision be a transverse one, it is observed that the margins of the wound, under like circumstances, come together and prevent the escape of the abdominal contents. This is easily understood when it is remembered that a muscle acts from origin to insertion, and in the long axis of its fibres.

The real factors, in the maintenance of the integrity of the abdominal wall and the position of the intra-abdominal contents, are the fascial sheaths.

The *histology* of fascia is also well known and agreed upon; doubtless also are its nourishing, limiting, and protecting powers; but it has not generally received adequate amount of recognition for the invaluable function it performs, in maintaining the integrity of the abdominal wall and retaining the abdominal contents in the abdominal cavity.

One naturally concludes, from experience of other such similar structures in various parts of the body that have a not too liberal blood supply, that its regenerative powers, owing to its poor blood supply would be relatively weak; but such, curiously, is not the case. Not only does it heal with great rapidity after it has been incised, but the union in the majority of cases is extremely firm; and this is probably due to the fact that it is composed of tissue elements which are not highly differentiated in structure.

Sound and firm union is, in the large majority of cases, further proved, when one has to reopen an abdomen after a transverse incision has been used; when it is almost invariably found that all that remains is a narrow firm line of strong fibrous tissue, uniting the cut ends of the muscle.

*Pathologically*, the remarkable healing properties of the abdominal fasciæ and sheaths, after being transversely incised, are probably explained as follows: All wounds heal by means of tissue which is reproduced from preëxisting mesoblastic tissue; in an aseptic wound a minimum amount of it is produced, but in a wound in which from any cause the healing process is delayed a

maximum amount of it is produced. Granulation tissue in large amount is not desirable, because its elastic properties are deficient and of poor quality. Any of the many factors that delay the healing process in wounds, if present, will cause a large amount of it to be produced, and the presence of blood-clot is probably the most common, due to incomplete hæmostasis at the time of operation. Blood-clot is a foreign body, and has no powers of regeneration or support; it simply keeps apart the edges of the wound and delays the healing process.

What is necessary is not the presence of blood-clot in the wound, but a plentiful supply of blood-vessels in the immediate vicinity, from which new vessels can be produced at the same time as regeneration is progressing in the other tissue elements of the incision.

The course of the blood-vessels is at right angles to the incision; and budding is said to take place more rapidly when a vessel is cut at right angles to its long axis than when partially torn or cut obliquely along with several of its branches; if it is cut straight across, there is no damage done to its branches, which are left unimpaired and ready to form a collateral circulation.

Therefore, the more perfect the mechanical closure of the wound in regard to the coaptation of the surfaces of the cut tissues, the more perfect will be the healing process.

It often happens, however, that no matter how careful one may have been in this suturing, a dead space develops, in which serum, etc., gathers, keeping the cut surfaces apart, and delays or prevents the permanent closure of the wound. This is now and again seen with the longitudinal incision, but practically never where the transverse incision has been used. The reason is that should the suturing in the transverse incision give way, the natural tendency for the edges of any transversely placed abdominal wound is to come together and not to separate. Further proof of this statement is found in the consideration of the normal physiological action of these muscles; and this is the flexion of the thorax upon the pelvis.

*Site of Incision.*—This depends upon the object of the operation. In the case of an exploratory laparotomy, one, just immediately above or below the umbilicus, has been found to afford comparatively easy access to all parts of the abdominal cavity.

In the majority of cases the operation is one of selection; and then, for purposes of description, one may divide the abdominals into two groups—the supra- and infra-umbilical incisions; or into three, the supra-, infra-, and trans-umbilical, with excision of the umbilicus.

These incisions vary in size, according to the nature and extent of the operation; their average length is about four inches, but this is sometimes considerably exceeded.

*Preparation of the Patient.*—There are many methods of preparation in use, but that usually adopted by the writer, except in emergencies, is as follows:

If possible, get the patient into hospital two days prior to operation, and



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put on a low diet. Have the bowels thoroughly well "moved." The diet is gradually curtailed, so that for the twelve hours prior to the operation nothing but fluids is given. It is found that when two or three days' preparation has been made, the post-operative convalescence is much more rapid.

The patient upon admission is bathed, after which the skin is washed with sterile soap and water, thoroughly dried, and then washed with spirit. Turpentine is then used to dissolve out the fatty matters in the skin, and thoroughly dried off. A piece of white lint soaked in a one-to-forty carbolic acid solution is then applied to the part, and changed every twelve hours, the last change being two hours before operation, when a one-to-twenty carbolic compress is applied, and not removed until the patient is on the table. Immediately before the incision is made, the part is thoroughly washed with spirit.

In an emergency case the skin is prepared as before, but acetone is used in place of the spirit, and the part then swabbed with a five per cent. alcoholic solution of iodine.

Iodine is objected to by many surgeons on the ground that some of the viscera are almost bound to come into contact with it, and, as a result of its action on peritoneal surfaces, post-operative abdominal adhesions are said to be more frequent than after many of the other forms of preparation.

*Method of Incising.*—The skin is firmly fixed between the first and second fingers, and a clean cut made through skin and subcutaneous tissue down to the muscle sheath. This is next incised and the muscle cut through. All bleeding points are now secured and the peritoneum opened. It is most important that a complete hæmostasis should be obtained. The round ligament of the liver is clamped between pressure forceps and then cut through; it is sutured separately. After the peritoneum is opened all bleeding points are ligatured. As a rule, four ligatures only are required, two on each side, for the superior or deep epigastrics, according to the part incised. And, as a rule, ligatures are not required for vessels in the subcutaneous tissues, pressure forceps being left on them until the peritoneum is opened; these are then removed, the pressure being usually found sufficient to produce complete hæmostasis.

Mr. Maylard has always objected to the spending of too much time in the ligation of every bleeding point, believing that in so doing there would be too much capillary occlusion, and the edges of the wound, after coaptation, would fail to be rapidly and freely supplied with blood.

*Method of Closure.*—Upon completion of the operation the peritoneum is grasped at either extremity of the incision, and on either side at its centre, by handled artery forceps. These are used in preference to pressure forceps because they exert no pressure upon the part grasped, and small areas of post-operative necrosis are thus less likely to occur.

In closing the peritoneum, Mr. Maylard grasps the end at which he will commence to stitch with two sharp single hooks, and when the first stitch has been secured, their further use is dispensed with.

The two ends of the round ligament are first firmly sutured together by one small mattress suture.

Under ordinary circumstances three layers of sutures are required to close the wound in the abdominal parietes; the first includes peritoneum and the posterior wall of the sheath of the rectus; the second, the anterior wall of the sheath of the rectus, including also the posterior wall, should there be any doubt about the hæmostasis; and the third a layer of sutures for the skin.

The technic of the introduction of these sutures is as follows: The peritoneum is closed by interrupted sutures of catgut, placed one-quarter of an inch apart from each other, great care being taken so that the cut edges of the peritoneum are everted and not inverted; if such be allowed to take place, post-operative abdominal adhesions are not only a possibility, but practically a certainty.

On the introduction of the suture, the knot is tied; the assistant grasps the double ligature one inch from the knot, and cuts it, one by one, as required, until the incision is closed.

The posterior wall of the sheath may have a separate row of interrupted sutures, but this is not really necessary.

The usual method is to use an interrupted suture, which is passed from the anterior surface of one rectus sheath, and brought to the anterior surface of the rectus sheath of the other side of the incision; this suture includes both layers of the rectus sheath and the contained rectus muscle. Before bringing the edges of the skin together the wound is thoroughly swabbed with iodine. This procedure is delayed until all the layers of the abdominal wall have been brought together, except the skin, so that there is no possibility of any of the iodine entering the abdominal cavity; and its object is the sterilization for any possible infection of the edges that might ensue during the various manipulations of the internal parts.

The skin may be closed by either a continuous catgut suture, an interrupted silkworm gut suture, or by Michel's metal clips.

When closed by a continuous catgut, and before the suture is tied, a gauze swab is taken, and rolled firmly along the whole length of the incision, so as to force out any blood or serum which may have collected between the edges during the closure of the wound. After this has been done, the suture is firmly knotted and a collodion dressing applied. When closed with clips or interrupted silkworm sutures, an anchor dressing is applied to the wound.

If the abdominal wall is very thick, a combined superficial and deep continuous catgut or silk stitch is used. This stitch has been used by Maylard for many years, but only recently has any publication dealing with the method been observed.

In *ANNALS OF SURGERY*, February, 1918, part 302, Sir J. O'Connor, K.B.E., of Buenos Aires, describes what he calls the Gallo stitch, for closure of the skin of the abdominal incision. It would therefore be more correct to call



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it the Maylard-Gallo stitch, or method of uniting the superficial margins of abdominal incisions.

Take a length of catgut and fix it at one end of the incision in the usual way; then enter the needle half an inch from the margin of the incision, carrying it down to its floor, and bring it out at a point exactly opposite that of entry, and at the same distance from the wound margin. The next stitch is the superficial one, the needle being entered one-eighth of an inch from the wound margin, taking only the thickness of the skin, and bringing it out at a point directly opposite to, and at the same distance from, the wound margin. This makes a most excellent suture, and by means of it subcutaneous and deep oozing are reduced to a minimum.

The anchor dressing consists of six-ply of butter gauze, rolled firmly together the required length, soaked in a one-to-seventy carbolic acid solution, and laid along the line of suture. No medicated gauze of any description is used, simply plain, white, sterile gauze.

When the abdominal wall is very fat, or when a ventral hernia has been dealt with, deep through-and-through silkworm gut sutures are used in the following way: A No. 6 silkworm gut is threaded on a large curved cutting needle; the needle is entered at from one-half to three-quarters of an inch outside of the cut margin, and is directed downwards obliquely towards the floor of the wound, which it crosses, and enters the opposite side, where it is carried through the subcutaneous fat for one inch; it then reënters the edge of the same side, and makes its exit through the skin, at the same distance from the wound, and about one inch from the point of entrance.

The method of tying these sutures is as follows: Three turns are taken, and the suture tightened to the required degree; either end is then separately taken and passed underneath the suture by means of a pair of dissecting forceps, grasped on the other side, and pulled through the loop left at the commencement of the procedure. By this means dragging on the skin and subcutaneous tissues is obviated; there is no tendency for the suture to cut into the skin, causing pain to the patient, and necrosis of skin and subjacent subcutaneous tissues.

By means of this stitch all possibility of a dead space existing between the edges of the wound is obviated.

The stitches are removed in from five to eight days after operation. To remove them, lift one end with a pair of dissecting forceps, and cut the strand between the knot and the skin; if this be done they are most easily removed; the important point to remember is that they must be cut at one or either end, between the knot and the skin, and not in the centre.

It is well to remember that when closing a transverse abdominal incision the patient, after the peritoneum has been closed, should always be raised to the horizontal position, prior to inserting the sheath or skin stitches; if this simple rule be borne in mind a great deal of time and trouble will be saved, since the edges of the wound tend naturally to come together.

If from any unfortunate circumstance it should be found necessary to drain either the peritoneum or the wound, it is done as follows:

A piece of rubber drainage tube of the required size is cut a quarter of an inch longer than the thickness of the abdominal wall, and stitched into the skin at one or other lateral extremity of the wound with the end of the gauze drain brought through it, the diameter of the tube to be according to the size of the drain required; thus, if one have primary reason to pack any part of the abdominal cavity for the control of hemorrhage, a large-sized tube is used; but if the requirement be, say the drainage of an abscess cavity, a tube of a quarter of an inch in diameter would be quite sufficient. The reason for the drainage gauze being brought through a relatively rigid channel is, that if it were simply brought out between the layers of the abdominal wall, it would undergo contraction; on the principle of capillary attraction drainage would be impossible. It should also be noted that when gauze is used for drainage it is thoroughly soaked in bismuth paste; this adds immensely to its drainage powers. Occasionally, as when one has operated for a large ventral hernia, a cigarette drain is laid along the muscle sheath, and brought out at one extremity of the wound; this is removed at the end of the third day. All of these gauze drains are thoroughly permeated with a thirty-three per cent. bismuth carbonate paste, which renders it markedly antiseptic, increases its powers of drainage, by assisting capillary attraction, and prevents the gauze from becoming adherent to bowel or peritoneum. There is also a strong possibility that it helps markedly to prevent the formation of intra-abdominal adhesions, and there is no doubt that gauze thus treated has not the irritating effect upon intestine that dry gauze has; also doing away with what in many cases would appear to be a contributory cause in the formation of a fecal fistula.

#### ADVANTAGES AND DISADVANTAGES OF THE TRANSVERSE INCISION

##### *Advantages*

1. Anatomically and physiologically correct.
2. Does not destroy the nerve supply of the muscles.
3. The muscular fibres being cut at right angles to their long axes, healing is more rapid and thorough.
4. Almost perfect apposition of the wound surfaces after suturing, it being the natural tendency of the margins of the wound to come together so that there is practically no strain put upon the sutures at any time.
5. As the fibres forming the anterior wall of the sheath are running transversely, and the stitches are entered at right angles, the risk of tearing of the fibres is greatly lessened.
6. Easy access to any part of the abdominal cavity.
7. Retractors rarely if every necessary; therefore surfaces of wound not bruised or injured.
8. Less shock to patient, owing to absence of retraction of margins of incision.

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9. Abundance of room, and complete freedom for all abdominal work.
10. Complete view of abdominal cavity and its contents; therefore the risk of swabs or instruments being left behind almost nil.
11. Easy delivery and replacement of viscera.
12. No tearing of peritoneum when being closed.
13. Practically perfect apposition of margins of wound; therefore no dead space for post-operative blood-clot, or serum, to collect and delay the healing process.
14. As the line of incision is in one of the lines of cleavage of the skin it is, after a few weeks, almost unobservable.
15. Very little if any post-operative pain.
16. If the patient be sick at any time subsequent to the operation, the pain in and around the incision is very slight, because the edges of the incision being firmly approximated, there is less tendency for them to separate.
17. Drainage with a transverse incision is much more efficient.
18. Post-operative convalescence as a rule, in uncomplicated cases, is practically uninterrupted, because there is less shock at the time of operation and less post-operative pain.
19. Average length of time in bed is less.
20. Post-operative ventral hernia is very rare.

### *Disadvantages*

As regards disadvantages, the only one of moment is the prolongation of the operation by perhaps two to five minutes; this, in the majority of cases, is negligible. It is questionable as to whether it does prolong the duration of the operation; because, while time is lost at one part, it is amply compensated for by the time saved in practically all other stages of the operation.

Mr. Maylard has personally informed me that he has seen a ventral hernia occur; but I have never seen one either in any of his cases or in any of my own.

The only adverse criticism of the transverse abdominal incision which has so far been noticed is in the *ANNALS OF SURGERY*, part 391, p. 632, where Doctor Meyer states that with this incision the layers of the abdominal wall do not come into as firm an apposition as they should, and that he was not using it as much as he did some years ago; from under the muscles one had for a time secretion. One hesitates to criticize the technic of a man of Doctor Meyer's standing, but I must say that I have never had any trouble, nor seen any trouble occur in any case, where approximation of the wound margins had been accurately obtained. In one or two such cases where such trouble did occur, it was found upon investigation that two or three of the deep sheath sutures had given, and a small amount of oozing had taken place. It might also be mentioned that Doctor Meyer was dealing with a case of gastric carcinoma, and it is well known how slow and imperfect these cases are in their healing; due most probably to the imperfect nutrition of the tissues forming the abdominal wall. It is not doubted that many individual surgeons

have their own individual objections to it; but its superiority over the longitudinal incision is unquestionable, because it is anatomically and physiologically correct.

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## ACUTE INTESTINAL OBSTRUCTION

ENTERECTOMY, PARTIAL EXCISION, INCLUSION, POST APPENDICAL  
INCIDENCE, TREATMENT OF STUMPS

BY SIR JOHN O'CONOR, M.D.

OF BUENOS AIRES

THIS essay has been indited with the intention of inviting surgeons to take stock of present methods of dealing with the most grave acute problem in general surgery, and if any of the suggestions herein contained should prove of any value in helping to diminish the incidence of acute obstruction of the bowels, or in enhancing the chances of surgical relief, the time and thought devoted to its composition will be more than recompensed.

Adopting the motto "Avoid the abstract and stick to the practical," I commence by posing the question, what is to be done in case of acute obstruction, when a portion of the gut is found gangrenous? Before responding, one has to bear in mind that, from the moment the circulation of the bowel becomes impeded, splanchnic shock and systemic poisoning begin, and both intensify in compound ratio to the hours which pass until the obstruction is relieved. General symptoms often prove delusive guides as to the existence of this lethal combination, which seems temporarily to possess an insidious potentiality only requiring some slight surgical stimulation to unveil its effect with appalling rapidity, and whenever gangrene of intestine is met with, not only is it proof positive that the case has, for one cause or another, been sadly neglected, but there exist initial factors, poison and shock, which seriously handicap any attempt at human succor. And while primary knowledge of these unpropitious facts may tend, in a way, to alleviate the sense of dire responsibility which everyone feels when he finds himself confronted with this tragic affection, yet it in no way deflects from the duty to spurn finesse and, even at the risk of the dead stymie, ileus complete, to give every patient outside articulo mortis a surgical chance, remembering that conscientious work accomplished in the shortest time is the one thing most likely to snatch a victory, the master stroke being elimination of the morbid trio, eventration, undue manipulation and prolonged anæsthesia.

With this preface I will endeavor to give a reply to the above question: Concentrate attention on the extent of the gangrene, carefully scrutinize the condition of the mesenteric zone, confine the attack to what is essential, and, as every moment counts, "force the game."

I do not hesitate to state that, next to having details of likely operations in clear mental perspective, there is nothing more conducive to operative celerity than, while the patient is being prepared (always including gastric lavage) personally to superintend the selection of instruments and drains, the threading of an adequate assortment of needles, the provision of an ample



counted supply of sponges, towels, and some rubber tissue, not omitting a few sterilized kidney basins, and the apparatus ready for any washing or injection which may be required, warming up the operating table, and last, and indeed not least, securing the help of two smart assistants.

There is also a contingency which may seriously interfere with expeditious surgery in acute intestinal obstruction—assuming previous examination fails to give an indication—a very perplexing question arises at the start: where to make the incision so as to get directly at the seat of mischief? I cannot conceive anything more demoralizing to a surgeon than, when entering the abdomen on a forlorn mission, to find his energy and time sapped, at the outset, in struggling to restrain inflated intestine from bursting out through the parietal wound, and if the site of lesion is not evident, and, as frequently happens, the distention is so great and the serous coat of bowels so friable that it is impossible to pass the gut methodically through the fingers in search for the constriction without causing numerous peritoneal lacerations. His position is truly pathetic, between the scylla of traumatism plus exposure and the charybdis of retreating without having reached the objective, both possessing one, and the same, mortal denominator, "Yet is their strength labor in vain."

These remarks are not penned on hearsay but on dire personal experience which incited me to publish a note in the *British Medical Journal*, November, 1918, on "the necessity to institute careful inquiry in every case of intestinal obstruction as to a previous attack of appendicitis," or to an abdominal operation in which the appendix might have been removed for convenience, and "that regardless of the time which may have elapsed—detail revision of the patient failing to point the path—a four-inch incision should be made in the right semilunar line low enough to expose the ileocaecal region and right pelvis where the distal ileum will usually be found implicated in adhesions," and while my experience may be exceptional, it suggests the personal conclusion that, excluding the era of iodine skin disinfection, and those which can be located before operation, in the majority of cases the obstruction of the small intestine will be encountered adjacent to the right pelvic brim, and that "the stereotyped central incision in such instances courts disaster, as in the search for the lesion the distended semi-paralyzed intestines are subjected to needless exposure and manipulation."

It is not pertinent to the context to analyze the psychology which inspires postponement of operation in acute appendicitis until what is academically styled "the cold stage" supervenes further than to interpolate that patients so treated who escape immediate translation to the glacial state remain endowed with a nest of adhesions which renders them likely candidates for premature mortification by the peristaltic contortions of their own small gut. And in parembolism I must add that I am unable to comprehend the mentation which complacently admits of "we'll wait until tomorrow to decide" in a case of suspected acute intestinal obstruction.

*Acute Obstruction of Small Intestine.*—In a number of instances in which

## ACUTE INTESTINAL OBSTRUCTION

stoppage is suddenly caused by a band or kink only a narrow ring or small knuckle of bowel is found gangrenous, and in quite a proportion of these necrosis does not extend to the fixed portion of the gut, much less to the mesentery, the fact of the circulation in the heart of the intestine remaining intact induces a hope that there might be prompt restoration of peristalsis in the tube if inclusion or excision of the moribund area could be effected without entailing subsequent obstruction by diaphragm or angulation. Acting on this hypothesis, I venture to submit a classification from the operative angle, and I trust the suggestion will be viewed merely as a humble attempt to find some means of reducing the terrible mortality—40 per cent.—which attends surgical intervention as expressed in mediate or immediate enterectomy.

"A." In cases in which one finds that a complete circle of the bowel is beyond redemption, I recommend that lateral anastomosis and excision of the gangrenous gut be carried out in the following order of detail:

- (1) The affected zone of intestine is drawn out through external wound, extruding a sufficiency, above and below, so as to facilitate the performance of lateral anastomosis at a convenient distance from the lesion.

- (2) The protruded bowel is fixed *in situ* by sponges which are meticulously packed into wound so as to preclude any possible regurgitation into the peritoneal cavity during subsequent manœuvres.

- (3) Coils of proximal and distal healthy bowel are approximated and held in apposition by an assistant while four Triollet catgut Lembert sutures, half an inch apart, baste the apposed loops together, each stay is tied when inserted and its free ends caught in a pressure forceps.

- (4) An opening, by sharp scalpel, two inches in length, is then made, close to and parallel with line of stays, into the distal gut—as no clamps are employed a kidney basin is made to catch whatever escapes—and then a pressure forceps is applied about the centre of free edge of incision to act subsequently as a tractor.

With a large kidney basin in position, a corresponding incision is at once made into the proximal bowel, free vent is afforded for escape of contents (the more the better omen) and the centre of free edge of this wound is similarly seized with a forceps.

- (5) Two assistants then make gentle opposing traction on adjoining stays, while a continuous through-and-through Triollet catgut suture (tautly secured to each stay in transit) seals the posterior segment, the ends of the "central" stays are then cut short.

The forceps previously attached to the free edges of wounds are now grasped by an assistant so as to indicate a strategic site for the insertion of two anterior "central" stays, the continuous catgut through-and-through suture is then carried on (as it approaches each stay the latter is tied and continuous suture knotted to it) until closure of the anterior segment is completed, the ends of stays are then snipped away, and the whole field is washed

with warm peroxide lotion, dried with bibules, and the anastomosed part is enveloped in a dry towel.

(6) The gangrenous portion is then taken in hand, a catgut ligature is applied at least two inches, respectively, above and below the proximal and distal suspect limits, the intervening necrosed intestine is excised, any bleeding point in mesentery is immediately dealt with. A purse-string catgut Lembert suture is next inserted around the base of each intestinal stump, with a few snips of a scissors each stump is then freed from its mesentery just enough to render it easy for an assistant to invert it, with a dissecting forceps, into its corresponding lumen as the purse-string is being tied.

(7) A jug of warm peroxide lotion (1 in 35) is again requisitioned, a general wash and brush up follows, everything is thoroughly dried, and bowel returned.

Four or five through-and-through strong silk sutures close the parietal wound, leaving room at one angle for passage of two thick silkworm gut wisps which are so placed as not to adhere to any line of intestinal suture.

"B." In some cases an incomplete narrow ring of gangrene results from constriction by band which in width more or less corresponds to that of the band itself; if this does not exceed one centimetre and the mesenteric zone is healthy, the affected coil is drawn out through wound and secured in place as before mentioned. Four equidistant long catgut Lembert stay sutures are then passed—skipping over the dead zone—through living proximal and distal gut; these sutures are not for the moment tied, their ends are respectively caught in forceps, the assistants with blunt hooks retract the loops of these stays well out of the way, while a kidney basin is placed in position and a transverse incision made through the whole extent of the gangrenous area (N. B., this incision is only made in cases where, after removal of the "external" obstruction, there is no consequent visible inflation of the distal bowel), thus free escape for contents is provided, when the flow ceases, the hooks are removed from loops, the forceps grasped and upper and lower intestine approximated, the stays are then tied and a forceps applied to each pair of free ends with which the assistants make opposing traction, while a continuous catgut Lembert suture, braced to each stay as it passes, completes the matter, the ends of stays being clipped away, the toilet, etc., is effected as in "A".

"C." The most difficult case for decision is the one in which a band, kink or twist has caused more extensive necrosis, the fixed portion of gut remaining suspect, and mesentery apparently uninvolved, the problem then arises, can infolding or excision of gangrenous section be accomplished without leaving an obstructive diaphragm or angulation? In order to clear perspective I wish here to mention that I cannot, as yet, recommend the adoption of either, if the belt of gangrene exceeds a width of one inch, anything above that commands the major procedure "A", but within this limit the complications mentioned can be obviated.

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Three long catgut Lembert stays are inserted, as in above, into proximal and distal bowel, one along free border and one on each side midway between this anterior stay and mesenteric attachment, blunt hooks are then made to pick up loops and retain them clear of the field while a free crucial incision is made through the moribund segment, when the intestinal discharge has ceased, the loops of stays being still held aside, the four gangrenous flaps (made by crucial incision) are liberally excised with scissors, the stays are then drawn taut so as to facilitate inspection of the amount of angulation produced by approximation of the proximal and distal gut, two similar lateral stays are next inserted close to mesenteric line embracing as much or as little of the peritoneal coat, above and below, as may be judged necessary to correct any likely kinking by the anterior sutures, the five stays are then tied and a continuous catgut Lembert suture applied as in "B".

The part stays take in the above procedures possibly warrants a little amplification. They, from beginning to end, make for rapidity and good workmanship in that they point the line for the continuous suture, help to secure its tension, and in themselves, form a strong second line of defence. They are infinitely preferable to clamps, as they do not cause any devitalization of tissue, which by the way, in acute intestinal obstruction is already sorely attenuated by distention and toxic infiltration. They possess a sound surgical attribute, viz., they admit of seeing a bleeding vessel and tying it. They serve as excellent pliable tractors by which the operator can dominate at will the slippery, sloppy ground on which he has got to work, and consequently are the best insurance against an attack of "the tail wagging the dog," at a moment when one carries a heavy time handicap in a race for life in the most fatal of acute surgical affections.

*Acute Colic Obstruction.*—In this catastrophe, if the problem as to the seat of lesion is not solved before operation, it may be taken for granted that what was mentioned as a contingent complication in acute "intestinal" is a certain one in advanced colic obstruction, and, owing to the enormous distention associated with the latter surgical intervention, as often as not ends in a tragedy. After a certain amount of prolonged pressure and manipulation necessary to retain intestinal balloons inside the abdomen, a rather sudden and unexpected relaxation of tension occurs which is apt to lure one on to proceed instead of beating a rapid retreat, but which in reality is the culminating exposition of intestinal paralysis induced by the superaddition of traumatic to preëxisting splanchnic shock. The curtain then drops as the anæsthetist whispers the epilogue—myocardial liquidation has begun.

Under such circumstances it is natural that one should seek for some mode of escape before the advent of the fatal loss of spring, and I cannot see anything promising on the horizon except in all cases in which through examination and careful study of the history fail to give a clue to the whereabouts of the obstruction, to make a right semilunar incision, explore gently for a few minutes, and if there is no result, proceed at once with the preliminary step of closing the wound by inserting four or five long through-and-through



strong silk sutures, and without knotting catch the ends of each in a pressure forceps. Then coax the left hand supinated and extended, between parietal peritoneum and bowels, over to the right iliac fossa, where two fingers flexed forward point the site for an incision large enough to allow the external inferior sacculatation of the cæcum to be drawn outside and maintained there momentarily by forceps. The semilunar wound is then rapidly closed, and a dressing applied, covered by rubber tissue and a towel, and immobilized by fixation forceps.

Attention is then turned to suturing exposed cæcal sac to margin of iliac wound in such a manner as to preclude any subsequent backward percolation. The patient is then gently rolled over on his right side to the edge of the table, a basin is placed in position, and a stab made into gut sufficiently large to give free vent to its contents.

I have had gratifying results with this method, and whenever feasible, I like to employ the external inferior sacculatation for drainage, as its site is strategic, it seems anatomically adapted for the purpose, it occasionally closes spontaneously after the obstruction disappears, and can be closed by operation without encroaching unduly on the lumen of cæcum.

The early insertion of the through-and-through silk closure sutures may require some explanation. These sutures, in place, help to prevent a rush from within as the wound can be promptly occluded by traction on their forceps and thus diminish pernicious handling of bowels. They afford good support for any temporary packing, their presence tends to obviate separation of layers of parietal wall during operation. Owing to internal pressure their introduction may be an arduous business which had better be effected, so as to save valuable time, before the fatigue stage supervenes; and the fact of their being in, affords a comfortable homeward-bound feeling, which, on occasion, is not to be despised. If long threads of silk are used the loops can be readily hooked away from field so as not to cause any operative inconvenience.

It may have been observed that I advocate an incision in the right semilunar line for both acute colic and acute "intestinal" (unplaced) obstruction, the reason for doing so being that if one reflects on the statistics of acute abdominal lesions of which 70 per cent. are credited to appendicitis, if to this be added the incidence of pyloric duodenal and biliary affections, the ratio of involvement of the right as compared to the left abdomen must certainly stand not less than eight to one, and, knowing that the most frequent cause of obstruction is the legacy peritoneal agglutination following infective processes and operations for their relief, the deduction is, to say the least, logical that, given no direct guide, the chances are greatly in favor of finding the lesion in the right abdomen. And as to the systematic search for obstruction by passing the gut through one's fingers, my experience dictates that this can be (when serous coat permits) as effectively done through a right semilunar as through any other incision.



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As to making a separate suitable opening in right iliac fossa for cæcal drainage, I am all in favor of it, for it appreciably diminishes the risk of subsequent virulent infection, and its consequences, in the large primary wound.

*Peritoneal Seclusion of Stumps.*—In 1903 I received my first object lesson as to the danger of leaving raw endothelial stumps in the peritoneal cavity, in the case of a well-known young lady on whom I performed double oöphorectomy for cystic disease, and as the appendix was very much in evidence I thought it expedient to remove it. This was done by a method in vogue at that period, viz., ligation and touching the stump with a disinfectant. As there were no adhesions, the whole operation was simplicity itself. Ten days later, she suddenly developed acute intestinal obstruction; the wound, under anæsthesia, was opened up, and to my intense disgust, I found the stump of the appendix glued to that of right ovary with a coil of congested ileum clutched in the adhesion. An uneventful convalescence ensued. Since then appendical stumps have, when possible, been buried in the cæcal wall or covered with an omental plaster.

The most recent reminder occurred in a married lady on whom I performed right oöphorectomy in October, 1920. As customary the appendix, for insurance reasons, was also removed and stump interred. On June 3, 1921, she was suddenly seized with violent abdominal pain and vomiting, which her doctor attributed to "acute gastritis"; various enemas and purgatives were ineffectually administered during the following four days. She was brought into hospital on the fifth morning, the abdomen was distended, stercoraceous vomiting incessant, no general symptoms beyond a distressed facial expression. A test enema was at once given, without result; as soon as the stomach was delivered of a basinful of dark green foul liquid she was transferred to the operating table. As parietal, vaginal and rectal examinations gave no indication, I made the usual right semilunar incision, immediately some coils of distended congested ileum bobbed up in the wound which were returned by bibule pressure, and the left hand was then introduced into right pelvis where it found a loop of ileum bound down, after the manner of a Christmas cracker, by a tense band about one centimetre in breadth and ten in length, passing from below cæcum to base of right broad ligament, the left index finger was gently insinuated beneath band and strictured gut and former elevated (without rupture) for inspection, then we found the silk ligature which had been placed nine months previously on meso-appendix, snugly encircling the band about half an inch from its upper point of fixation, affording a direct and positive proof that the band had originated in and included the stump of the meso-appendix. A small cæcal scar indicated the tomb of the appendix, and the right ovarian stump was free and had contracted to the size of a pea. The band was excised and gut drawn up into wound, a belt of gangrene, corresponding to width of band, involved the greater part of free zone of bowel. Stays were inserted, and as peristalsis had

visibly resumed its function, the necrotic segment was infolded (without incision) by stays and a continuous Lembert catgut suture. Prompt recovery followed.

Some months previous to this, while pondering over the matter of how to reduce contact to a minimum when dealing with the stump of an infected appendix, I stumbled into a very simple method of secluding the stump of the appendix and that of meso-appendix by one ligature in one peritoneal pocket, and, "en passant," I may add that my colleague, Doctor Fehilly, and I have employed it in many cases and find it as useful as it is practicable.

(1) The meso-appendix is ligated and appendix isolated in the usual manner; the ends of ligature are not cut away.

(2) A curved intestinal needle is then attached to one end of this ligature and a three-insertion (two lateral and one anterior), purse-string suture is passed, at a distance of about one-third of an inch, around the base of the appendix; the anterior point of suture is purposely inserted beneath the anterior longitudinal band.

(3) The needle is then removed and the ends as well as the loops of the purse-string are left loose and kept out of the way while the appendix is clamped at level of cæcum separately ligated, and cut away.

(4) The ends of the "ligature suture" are then sought for, and as they are tied together (the assistant with a dissecting forceps pushing the appendical stump backwards) both stumps instantly and definitely disappear from view—only two things touch the raw surface of the stump of appendix—the knife and the dissecting forceps.

The above is the first instance in which I found the stump of the meso-appendix *in flagrante delicto*, but I have often suspected its complicity in pelvic adhesion jungles; however, knowing the tendency that peritoneum has to adhere to any raw surface, I think I may safely advocate burial of this stump, particularly as both it and its mate (of the appendix) can be readily interred together with the same bit of string.

*Peritonization of Stump After Salpingo-oöphorectomy.*—After periodic attempts at rotating the ovarian or salpingo-ovarian stump downward and suturing it face backward on the anterior shelf of its broad ligament, I have definitely abandoned the procedure as I found it, almost impossible to avoid, even with blunt instruments, the occasional formation of a troublesome intra-ligamentous hæmatoma, and moreover, the manipulation necessary for such adjustment endangered the security of the pedicle ligature.

Instead, I have adopted a much more simple and more readily applicable method which can be always resorted to without "asking for trouble," viz., a web, about one or two inches square, is excised from the omentum and plastered over the surface of stump, and a piece of fine silk (or the ends of the ligature) is made to secure it, in bonnet fashion, around the neck of same. In infected cases I always employ catgut instead of silk for ligation of pedicle and for fixation of this omental "patch."

## RECTAL AND VESICAL INCONTINENCE RELIEVED BY OPERATION

By JOHN G. SHELDON, M.D.

AND

EDWARD P. HELLER, M.D.

OF KANSAS CITY, MO.

M. K., male, age twelve years, was brought to the Vineyard Park Hospital in June, 1921, for relief of incontinence of urine, with a history that he had never had any control of his bladder, and had always had to wear a diaper. At night, and when recumbent, drainage is less. He was born with an imperforate anus. (Figure 1.) When 24 hours old the attending physician inserted a knife into the anal region, and succeeded in entering the pouch of the rectum. He sutured the cut edges of the rectal pouch to the skin (mother's statement). These sutures did not hold, and a second operation was performed three days later.

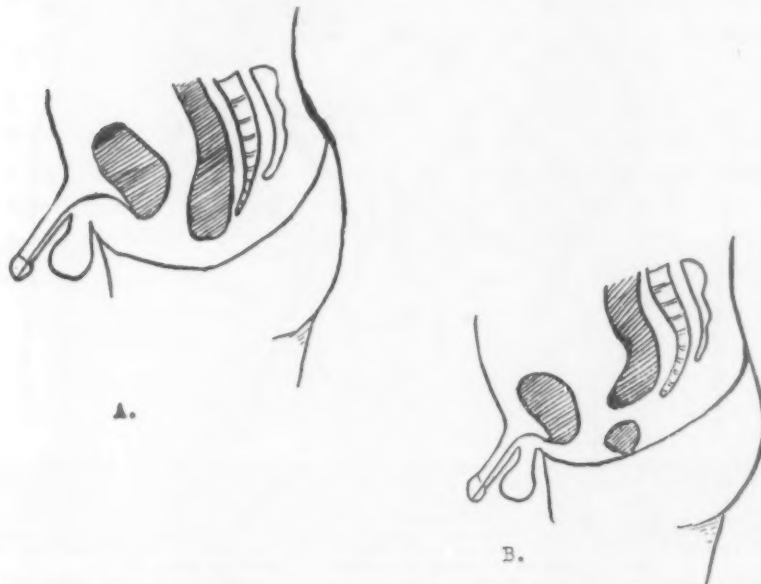


FIG. 1.—(Stewart.) A. Imperforate anus,— the original condition in the case herewith reported. B. Imperforate rectum. In the present instance there was no evidence of an anal pouch.

This operation was successful as far as establishing an anus was concerned, but there was no control of the bowels. At the age of three, he was taken by his parents to a surgeon in the Northwest, who performed a muscle-flap operation (mother's statement). Two weeks later the flaps had to be cut as no bowel movements were possible. The child's condition was now as before operation. Nothing was done, however, until two years later, when he was taken to a large clinic in the Middle West, where a "puckering-string operation was done" (mother's statement). At this time, an attempt was made to correct the enuresis by passing a catheter at regular intervals. Two weeks after return to his home, he was in the same condition as before operation. He remained in this state of incontinence of urine and feces until November, 1919, when he came under our

observation. When admitted he had an incontinent anus with no sphincter that could be discovered. There were scars about the anus, the result of previous operative procedures. It was decided at this time to attempt to provide a rectal sphincter from flaps of the glutei maximi. Since four weeks after operation, (a space of 18 months), he has had perfect control of his bowels. No attempt was made to correct the enuresis, and it is for this condition that the child has been brought back for treatment.

*Family History:* Negative. There are three younger children in the family, all of whom are physically perfect.

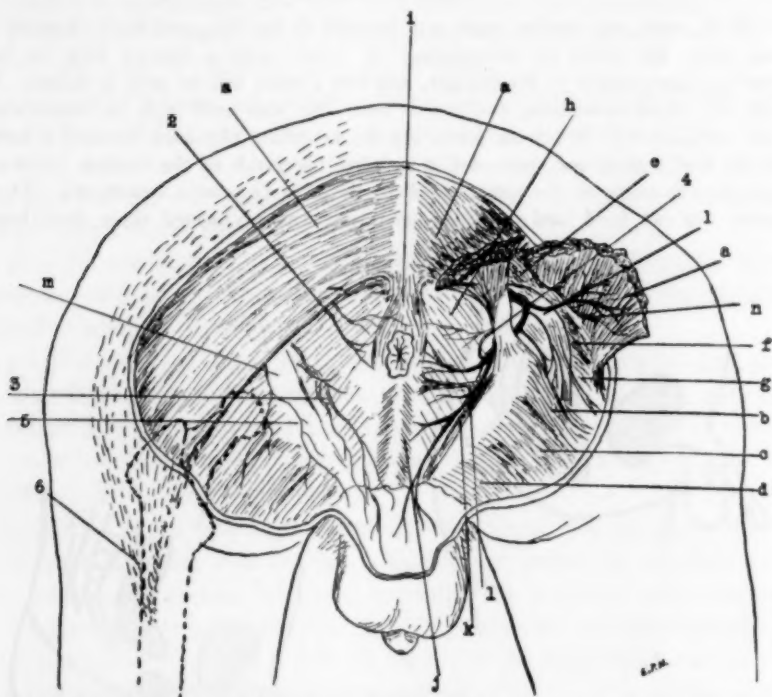


FIG. 3.—(Treves, after Rüdinger). The male perineum. a, gluteus maximus; b, semi-tendinosus and biceps; c, adductor magnus; d, gracilis; e, pyriformis; f, obturator internus; g, quadratus femoris; h, levator ani; i, external sphincter; j, bulbo-cavernosus; k, ischio-cavernosus; l, transversus perinei; m, tuber ischii; n, inferior gluteal nerve (branches). 1, sciatic nerve; 2, inferior hemorrhoidal vessels and nerve; 3, superficial perineal vessels and nerves; 4, pudic (internal pudendal) nerve (cut) and pudic artery; 5, perineal branch of posterior cutaneous of thigh; 6, semi-diagrammatic representation of attachment of gluteus maximus (a modification added by one of us).

*Physical Examination:* A well nourished boy, surgically negative except for scars over both gluteal regions, (Figure 2), and obliteration of the gluteal folds, the result of the previous operation in which a muscle-bundle from each gluteus maximus was swung around the rectum. There is no control of micturition, and a diaper is worn constantly. The urine drainage is worse when he is up and about—the urine dribbling from the urethra at a slow steady rate. On assuming the recumbent position the flow is somewhat less.

*Description of First Operation.*—Formation of rectal sphincter. (November, 1919.) With the patient in the reversed Trendelenburg position, long incisions were made in line with the fibres of the gluteus maximus muscle on either side, and extending approximately three inches above and three inches below the tuberosity of the ischium on each side. (Figure 2.) Having isolated the mesial fibres of the gluteus maximus on one side, a search was begun for branches of the in-

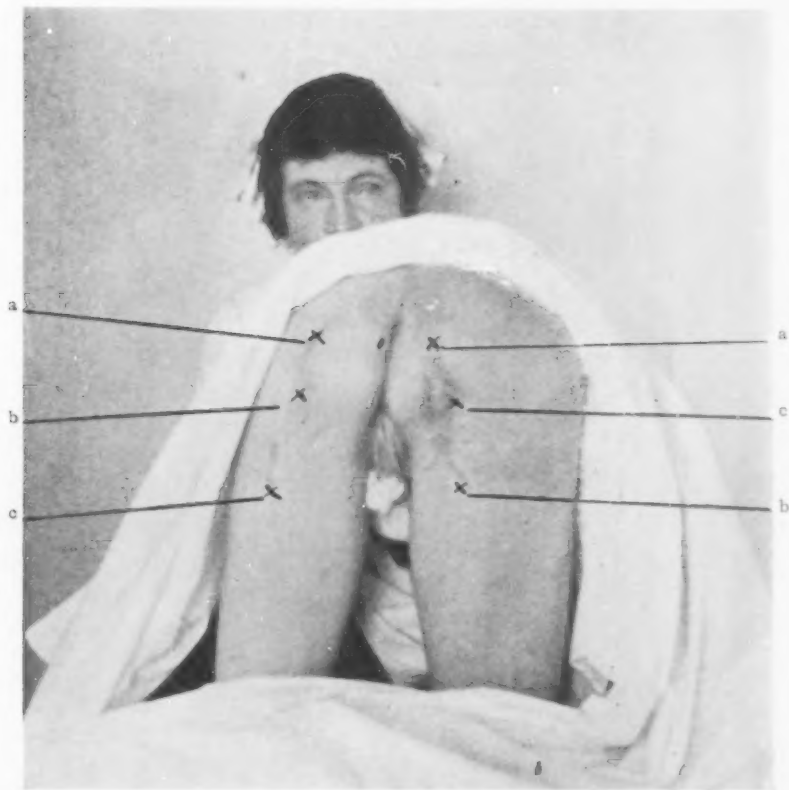


FIG. 2.— (Photograph taken 18 months after operation). a. Upper end of incisions; b. lower ends of incisions; c. position of ischial tuberosities. The patient has purposely been placed in the same position as when operated upon. It will be noted that the gluteal folds have been obliterated because of the underlying muscle bundles. Note the deep perineal crease.





## RECTAL AND VESICAL INCONTINENCE RELIEVED

ferior gluteal nerve. (The inferior gluteal nerve arises from the posterior divisions of the 5th lumbar and the 1st and 2nd sacral nerves; it leaves the pelvis through the great sacro-sciatic foramen, below the pyriformis, and divides into branches which enter the deep surface of the gluteus maximus muscle.) For success it is necessary that a good innervation be secured for the flap. (Figure 3.)

Having isolated a bundle of muscle fibres about 2 inches in breadth, with the necessary nerve supply, the bundle was separated from the upper angle of the wound down to the femoral attachment. Here a strip of periosteum was removed

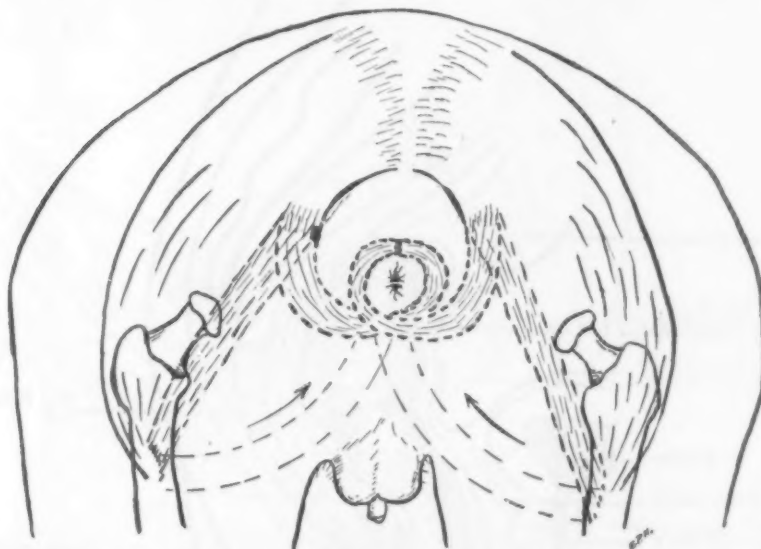


FIG. 4.—Diagrammatic representation of the method by which the sections from each gluteus maximus were detached and swung around the anus beneath the superficial structures of the perineum, and sutured together.

with the muscle in order to prevent fraying of the ends of the fibres, and to assure secure anchorage for the sutures which were to unite this muscle bundle with its fellow of the opposite side.

By the same procedure the other gluteus maximus was isolated and a similar muscle bundle, with a large branch of the inferior gluteal nerve, separated throughout the length of the incision, and including the periosteum of the femur below the great trochanter.

By blunt dissection a channel was tunnelled completely around the rectum—or better, around the anal canal. By retracting the undermined skin, and by sliding first one muscle flap and then the other around the rectum as shown in Figure 4, the ends of the flaps were brought into apposition, and sutured together with chromic catgut.

After hæmostasis, a rubber drain was inserted into each wound to care for the secretions of the first 24 hours, and the wounds closed with silkworm gut sutures. The patient was made comfortable by changing his position from one side to the other. Healing of the wounds was uneventful. At the end of the third week, there was some evidence of control of the bowels. At the time of dismissal—the end of the fourth week—there was control of the bowels during the day. One week after returning to his home in Idaho, the boy states that he discovered how to control his bowels, and that gradually this control became involuntary. Now his improvised sphincter remains contracted, or on guard, so to speak, at all

times except during the act of defecation. A point of interest is that the sphincter contracts independently of the remaining portions of the gluteus maximæ.

*Description of Second Operation.*—*Correction of vesical incontinence*, June 17, 1921.

In view of the previous history, the success of the first operation, and on the assumption that a fetal type of bladder was responsible for the persistent incontinence of urine, an operation was agreed upon for the relief of the enuresis.

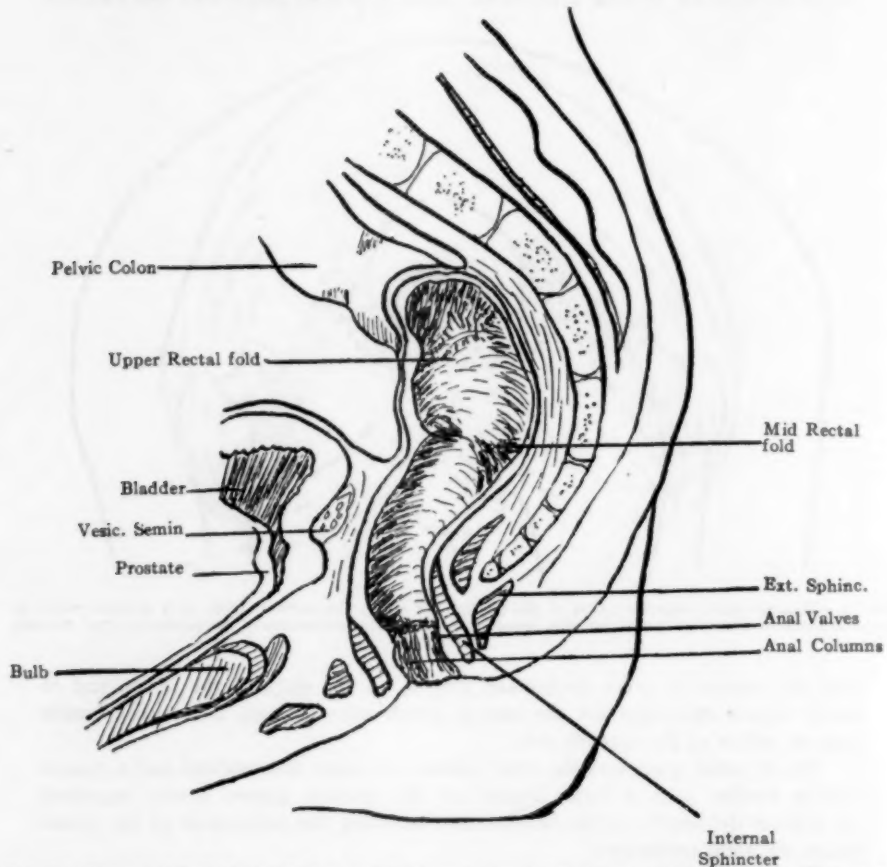


FIG. 5.—(Treves, after Prof. A. M. Paterson.) Diagram showing the stages of the rectum and the anal canal on mesial section. This figure is interposed to illustrate the normal arrangement of the structures about the anus and rectum. In the first operation reported herewith, it will be seen that the muscle flaps take the place of the internal sphincter, and to a large extent, of the external sphincter also.

A three inch suprapubic incision was made, and the structures carefully inspected layer by layer. Much to our satisfaction, our assumption proved to be correct, for on arriving at the peritoneum, the urachus was found to be patent up to within two inches of the umbilicus, and both hypogastric arteries were pervious and of good size. These three structures were divided and ligated properly on a level with the upper limit of the fundus of the bladder. The bladder was then pushed well down into its proper position in the pelvis. (See Figure 6.) A short rubber tube drain was inserted down to the prevesical space, and the wound closed with silkworm gut sutures.

In order not to leave undone a procedure which might aid in his recovery, a circumcision was performed.

## RECTAL AND VESICAL INCONTINENCE RELIEVED

As far as the wounds were concerned, recovery was uneventful; the rubber drain was removed the day after operation, and the sutures were removed from the abdominal wound on the seventh day. He was up in a chair on the fifth day and was walking about on the ninth day.

As to his bladder condition, the following notes were taken from the Progress Record: First day post-operative, there was some discomfort at glans penis, and some burning on micturition—due probably to the circumcision. Second post-operative day, uneventful except for frequency of micturition—capacity 25 to 50 c.c. urine, with knowledge of start of act of micturition. Fifth post-

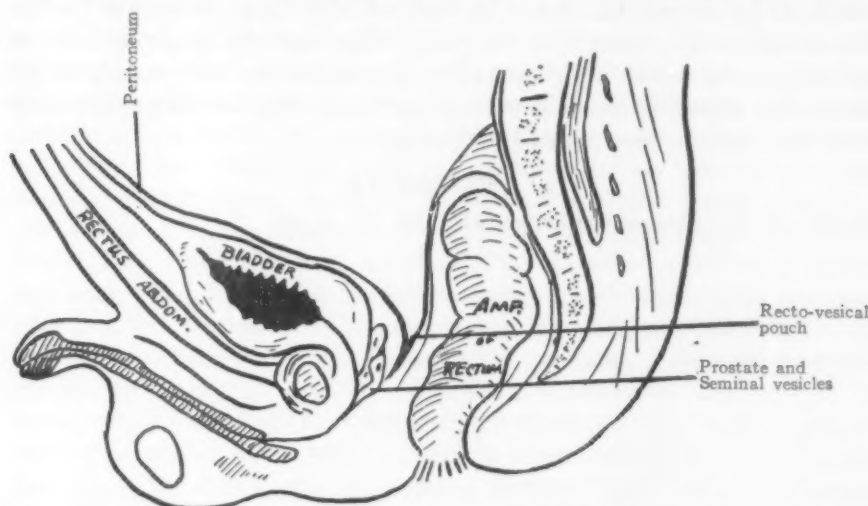


FIG. 6.—(Gray's Anatomy, after Corning.) Mesal section through pelvis of a new-born male. This diagram shows the position of the bladder as found at the time of operation (second operation herewith reported), with the exception that the cavity of the bladder extended further upward into the urachus. The urachus, or middle umbilical ligament is the impervious remains of the tubular canal of the allantois, which existed in the embryo, and a portion of which expanded to form the bladder: It passes upward from the apex of the bladder, between the transversalis fascia and the peritoneum, to the umbilicus, becoming thinner as it ascends. It is composed of fibrous tissue, mixed with plain muscle fibres.

operative day almost complete control of micturition, and increase in capacity of bladder to 300 c.c. Sixth post-operative day, no longer kept urinal over penis, but requested it at intervals. Control absolute. Still some frequency. No dribbling. Ninth post-operative day—no dribbling while walking about. In knee-chest position for 20 minutes while photographs of gluteal region were being taken and no dribbling occurred. Eleventh post-operative day was dismissed, and to date has had no recurrence of enuresis.

*Comment.*—It has been stated in the foregoing that the form and position of the bladder were believed to be the cause of the urinary incontinence. The diagnosis and the operative procedure were based on the Goltz theory of micturition. In 1874 Goltz<sup>1</sup> evolved the theory that micturition is due to the following causes: The presence of urine in the urethra resulting from distention of the bladder, contractions of the bladder, or positions of the bladder or patient, were responsible for the desire to micturate. While it is true that the work of Guyon and others apparently disproved the correctness of this theory, we have several clinical observations that support it in some cases. The formation of a rectal sphincter involved purely mechanical and anatomic considerations.

CONCLUSIONS

In view of the operative findings and result obtained in this case, we shall investigate with interest the position and shape of the bladder in all cases of urinary incontinence.

Regarding the rectal operation, this case, and an experience with two others of a similar nature, prompts us to record mistakes which were made in our first operations of this type: (1) The fibres of the gluteus maximus should not be severed, but should be detached with the periosteum at the site of insertion on the femur; (2) the muscle flap should be ample, at least an inch in diameter—even in children; (3) if possible, the nerve supply of the muscle flap should be investigated, and retained even if a large portion of the muscle must be incorporated in the flap.

REFERENCE

- <sup>1</sup>Archiv für die gesammte Physiologie, 1874, Bd. viii, S. 478.



## SECONDARY FOCI OF TUBERCULOSIS IN THE SPINE IN POTT'S DISEASE

BY CHARLES W. PEABODY, M.D.

OF BOSTON, MASS.

STUDY FROM THE ORTHOPÆDIC CLINIC OF THE MASSACHUSETTS GENERAL HOSPITAL

ABOUT six months ago on the Orthopædic Service of the Massachusetts General Hospital a patient had been scheduled by the writer for operation who was to have a bone graft for Pott's disease of the dorsal spine, an extensive process having destroyed the ninth and involved the eighth and tenth dorsal vertebræ. Just before the hour of operation during, the weekly "ward rounds" on the service, the X-ray plates of this patient among others were demonstrated to the members of the staff. At this point, to the writer's chagrin, the Chief of Service, Dr. R. B. Osgood, called attention to a vertebral body lying at the lower edge of the exposed field. Its outlines were much obscured by the shadow of the cylinder of the Röntgen tube, but on close inspection it appeared to be distinctly wedge-shaped. Between it and the process above lay two normal bodies and intervertebral discs, and for this reason no attention had previously been directed to it. The significance of this finding in relation to the proper operative procedure was of course apparent, and the latter was postponed pending further X-ray study. Subsequent plates were confirmatory, showing a typical deformity of the second lumbar vertebra and the disappearance of the disc space below it. In other words a secondary focus was present in this spine. Unless this second focus had spontaneously healed during the post-operative recumbency, which is unlikely, as in this clinic this period is not a very extended one due to the internal fixation, its progress would have been aggravated by reason of the increased strain from the immobilization of the overlying spine, and the patient would have been as bad off with his lumbar Pott's as he had been with the dorsal. But while relief was felt at the timely discovery, it was generally felt too rare an occurrence to be seen again.

A few months later a patient presented himself for examination by the writer in the Out Patient Department who had had a bone graft for a mid-dorsal Pott's about eight months previous. He was wearing a light back brace but complained of the same pain and weakness in back as before operation and localized a point of tenderness a little lower down. X-rays were taken, and to our surprise the plates, showing the graft in place in the spines of the sixth to eleventh dorsal vertebræ, also showed a disappearance of the disc between the last dorsal and first lumbar and a deformity of the body of the latter. The process above centered in the ninth dorsal and involved the two adjacent bodies, leaving a normal segment between it and this lower one. Recalling the case first cited, we forthwith looked up the Röntgenologist's interpretation of the pre-operative plates of this second patient, with the

discovery that apparently this second lesion had been distinguishable even then, although the wording was a little misleading and gave the impression that the lesions were in continuity. After some search these original plates were also found, and, while the lower area was not clearly in focus, comparison of the two sets showed that a definite secondary lesion clinically unrecognized had existed prior to operation.

Within a few days after this incident the writer examined and sent into the ward for study a young Italian laborer with a large low abdominal mass, a contracted hip, and indefinite symptoms in back suggesting a low lumbar or pelvic tuberculosis. The initial X-ray examination revealed an early destructive process in the fifth lumbar vertebra. As this did not appear very far advanced it was thought by the staff insufficient to explain the large psoas abscess present, and further X-ray study of the spine was made. This revealed an advanced Pott's disease with encircling abscess shadow in the lower dorsal spine.

The findings initiated a discussion in the clinic of all three cases, which brought out the fact that a patient had recently been operated on by the fusion method for a tubercular process developing some time after a previous bone graft, but at a slightly lower level than the first.

Thus within a space of less than six months four cases of distinct secondary foci in the spine had come under observation in one clinic; yet the prevailing opinion therein was that such a condition was exceedingly rare. Two questions presented: Were we working under a considerable misapprehension regarding the incidence of an important complication of Pott's disease; or have the usual methods of examination been too limited to reveal this phase? The first question seemed easy to answer, and the Index Medicus was turned to; but in the titles for the last ten years no mention of this matter of secondary foci was found. Did this indicate that it was a condition too rare to be of importance, or too common to merit emphasis? With the latter possibility in mind the standard text books on Orthopædic Surgery were consulted. Out of five examined only one made reference to secondary foci in the spine, that of Whitman mentioning a series of 1356 cases in which sixteen, or less than eight-tenths of one per cent. showed lesions in two regions. But these findings were obtained from tracings made of the spine and not as a result of X-ray examination. Still convinced that the problem could not be so rare as apparently indicated by the scarcity of reference in the literature, it was determined to seek information from the fairly considerable number of cases of spinal tuberculosis on record in this hospital. Diagnosis files were found to contribute nothing in this regard. Dispensary record notes contained little detailed information and were equally unproductive. On the other hand scrutiny of a portion of the mass of ward patient records proved so time consuming that some short-cut was sought. It seemed apparent that in the last analysis the only confirmative evidence of absolute value would arise from the X-ray data on a case, and hence the most productive endeavor would be in the records of this department, which was inclusive of both O. P. D. and ward

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cases. The diagnoses in all examinations made since 1913 were found still on file. Those finally and definitely diagnosed as "Pott's Disease" or "Tuberculosis of the Spine" were segregated, amounting to 315 patients (the total number of examinations made on these patients being of course several times greater, appearing in succeeding years). The original descriptive cards of these examinations were then consulted for a detailed interpretation of the X-ray picture. For the first six-year period these were found disappointing in value, in that a detailed report was lacking, and a summary only appeared, such as "Old Pott's Spine" or as "Tuberculosis of Dorsal Spine." However

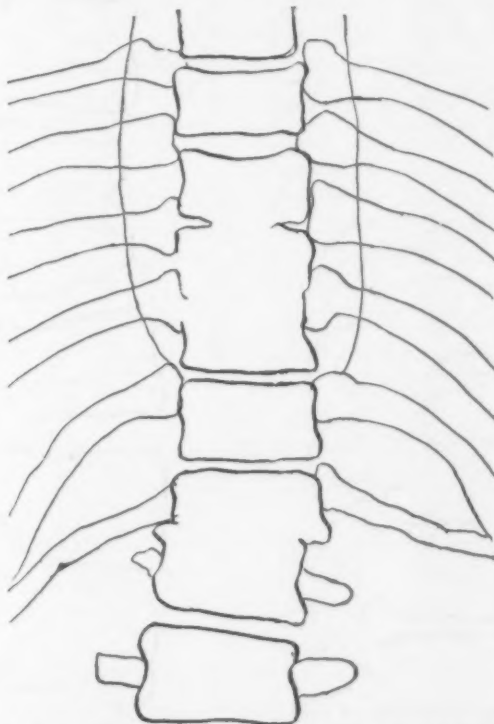


FIG. 1.—Case VII.—Jos. W. A-P view of dorso-lumbar juncture showing typical lesion in lower dorsal spine and also one in upper lumbar area.

in this group several instances occurred in which even in the abstracted form note was made of two foci being present. From late 1918 to date the records contained the complete dictation of the röntgenologist; and in this latter period were found five cases in addition to the four described at the beginning of the paper with a definite observation of secondary foci. The reported findings of the thirteen patients follow. Each report concluded with the diagnosis of tuberculosis.

Group I. Two hundred cases, four with secondary foci, or two per cent.

Case I. Stephen T., No. 2193. "A pathological process involving first and second lumbar and also one involving the fourth and fifth lumbar."

Case II. Mario L., No. 41376. "A destructive process involving twelfth dorsal and first lumbar and intervertebral disc, also third and fourth lumbar and disc."

Case III. Morris R., No. 37866. "The seventh dorsal is partly destroyed; there is also a destructive process involving ninth and tenth dorsal."

Case IV. Carline V., No. 41826. "Rather extensive destruction of body of the fifth dorsal vertebra; process seems confined to the body; the seventh is distinctly wedge-shaped, diagnosis deferred." A year

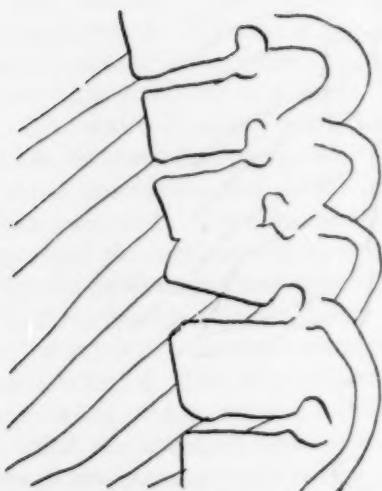


FIG. 2.—Case VII.—Small plate focussed over lower dorsal and showing appearance of lesion here in lateral view.

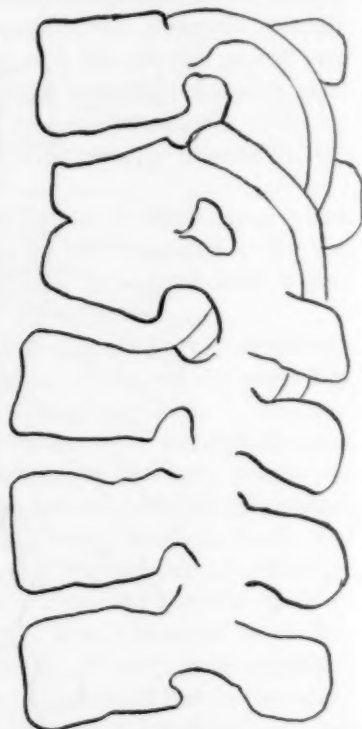


FIG. 3.—Case VII.—Lateral view of lesion in upper lumbar spine.

later examination showed abscess shadow and definite diagnosis of tuberculosis was made.

Group II. One hundred and twelve cases, nine with secondary foci, or eight and two-tenths per cent.

Case V. Lorenzo B., No. 64014. "There is a destructive process involving eighth and ninth dorsal vertebrae and disc; also a process in first and twelfth", and first lumbar.

Case VI. Amelia D., No. 57041. "The tenth and eleventh dorsal are fused; the first lumbar and disc below are also affected."

Case VII. Joseph W., No. 37537. "The ninth and tenth dorsal vertebrae are partly destroyed; there is also a process between the first and second lumbar."

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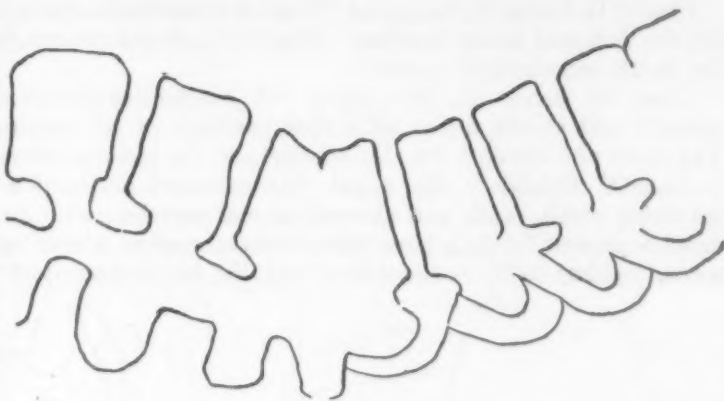


FIG. 4.—Case X.—Epthia S. Lateral view of lumbar spine showing fusion of second and third vertebral bodies. Above them is a normal segment and at the top of the plate evidence of the pathology in the dorsal spine can be made out.

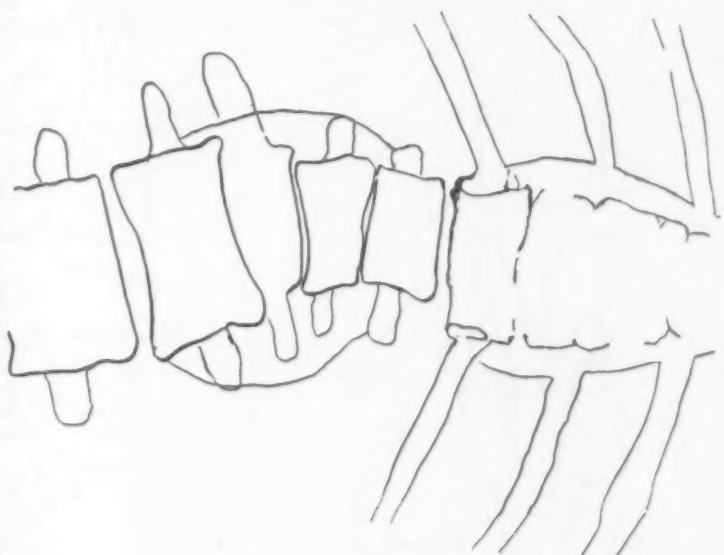


FIG. 5.—Case X.—A-P view including both lesions. A dense abscess shadow overlies the dorsal one.

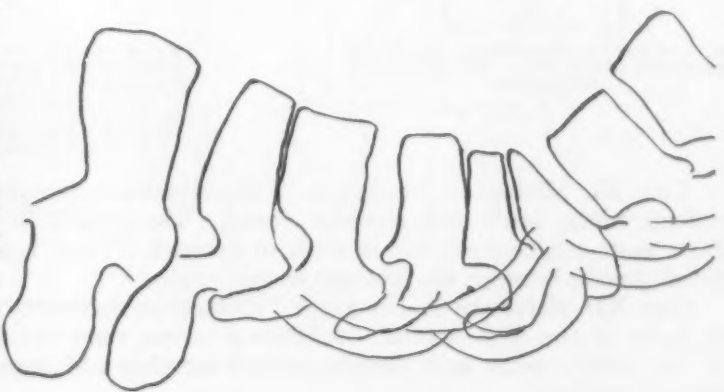


FIG. 6.—Case XI.—Michael S. Lateral view of dorsal spine with a destructive process shown and a normal subjacent area.



Case VIII. Grace T., No. 49324. "There is a destructive process involving the first and second lumbar. There is a second process involving the tenth and eleventh dorsal."

Case IX. James H., No. 54518. "A destructive process involving seventh and eighth dorsal with disappearance of intervening space. The tenth and eleventh are also affected and the space narrowed."

Case X. Ephthis S., No. 64418. "An extensive destructive process involving ninth, tenth and eleventh dorsal vertebrae, with an abscess shadow present." At a later date: "plates confirm above and show second lumbar to be wedge-shaped and disc below destroyed."

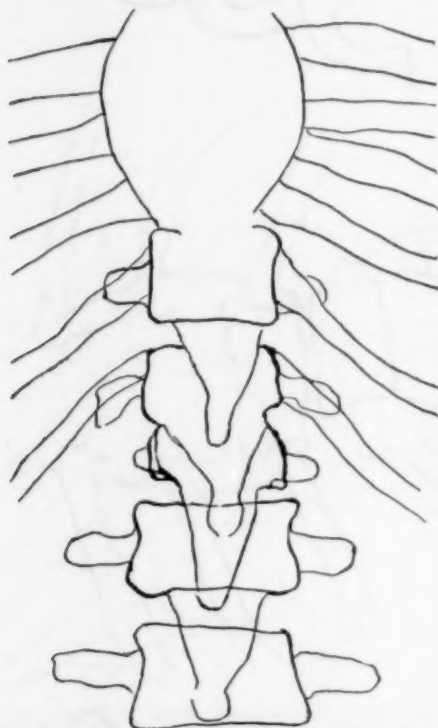


FIG. 7.—Case XI.—Dorso-lumbar area in A-P view showing evidence of an additional focus in lumbar spine.

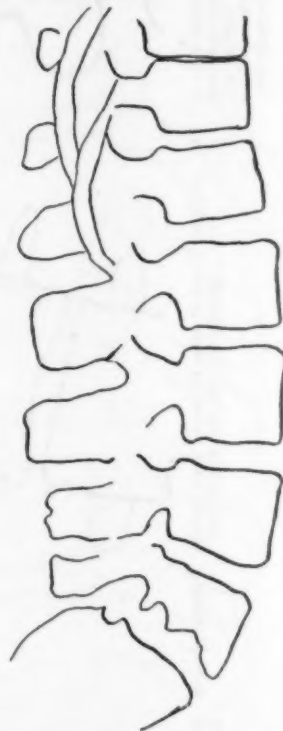


FIG. 8.—Case XII.—Sebastiano C. Lateral of lower spine, the fifth lumbar being seen definitely diseased, and at the top of the plate the disappearance of the disc between the eleventh and twelfth dorsal indicates another process in this region.

Case XI. Michael S., No. 63955. "Extensive destructive process involving ninth, tenth and eleventh dorsal. The twelfth is normal. Bone graft can be made out in sixth to eleventh. There is an additional process between the first and second lumbar."

Case XII. Salvatore C., No. 72831. "Plates show destructive process in body of the fifth lumbar. Additional plates show involvement of the ninth, tenth and eleventh dorsal vertebrae with surrounding abscess shadow."

Case XIII. Mary C., No. 57877. "Tuberculous process involving

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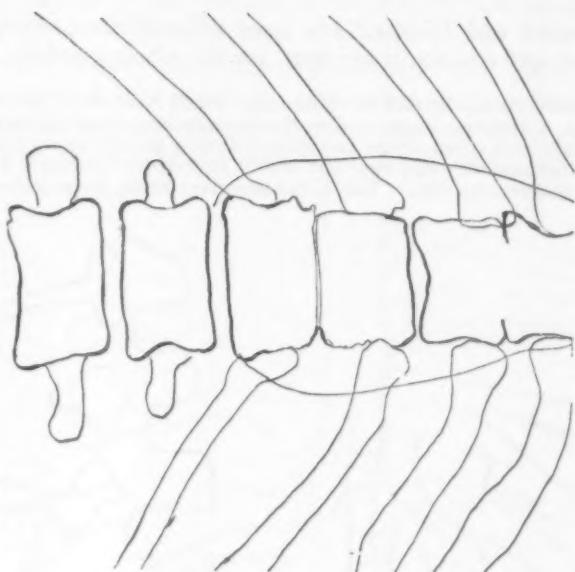


FIG. 9.—Case XII.—Process in lower dorsal seen in A-P view, abscess shadow present.

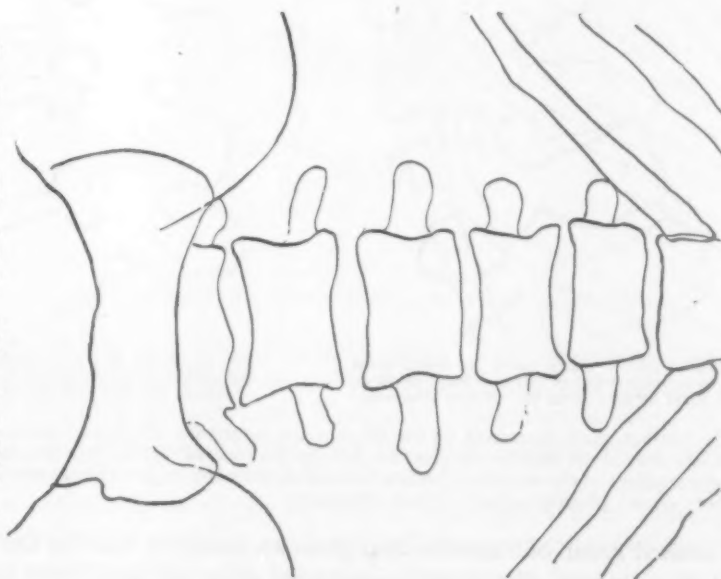


FIG. 10.—Case XII.—A-P view of deformity in fifth lumbar.

ninth, tenth and eleventh dorsal vertebrae with bone graft in place. There is a process below the graft involving the twelfth and first lumbar."

Total of groups I and II equal 312 cases with thirteen secondary foci found, or four and one-tenth per cent. for the whole number.

NOTE:—The illustrations are limited to those cases which have been personally observed by the writer, i. e. the four mentioned in the introduction, listed as cases ten to thirteen inclusive, and also case seven, whose two spinal foci were simultaneously recognized and appropriately treated several years ago, but who is still under treatment for a subsequently developing tuberculous hip. The X-ray negatives of all these patients were

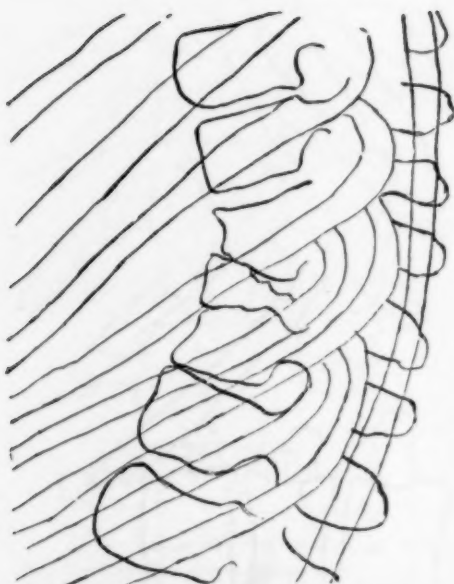


FIG. 11.—Case XIII.—Primary focus in dorsal spine seen from side. The shadow of the bone graft in this case could be seen along the spinous processes.

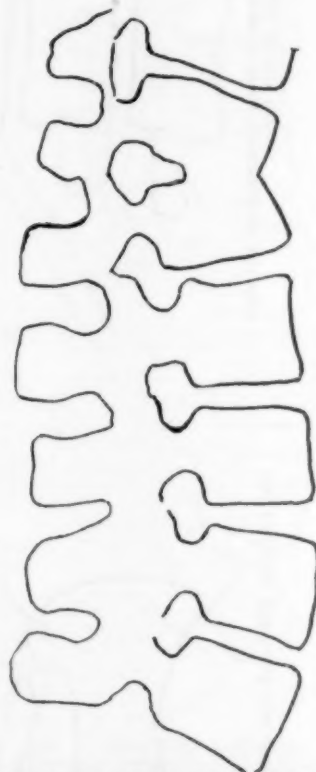


FIG. 12.—Case XIII.—Lateral of lumbar area showing disappearance of disc between the first and second bodies.

sufficiently distinct when examined on the illuminated screen for all clinical purposes, but unfortunately proved not sufficiently clear to photograph successfully for reproduction here. Accordingly tracings of the vertebral bodies were made over the original illuminated plates, and are here shown photographed without alteration.

This limited group of statistics thus gives an incidence rate for the whole of about four per cent., the second period over eight per cent., with the first only two per cent. In spite of the discrepancy between the rates of the two groups, it may be that the rate in the second is nearer the real incidence than the percentage of the combined total, a fair inference being that the brief summaries given in the records for the first period did not indicate all the

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findings in each case that might have been observed in a reading of the plates, as found in the detailed reports available in group II. The writer, furthermore, is inclined to put forward the suggestion that the highest figure given may be below the real incidence of this condition. Reasons which may be advanced to support this suggestion are as follows: (1) In almost every case the discovery of the second focus has been more or less by chance, that is neither clinician nor röntgenologist were searching with this in mind. (2) In a very considerable number of these Pott's cases the plates taken

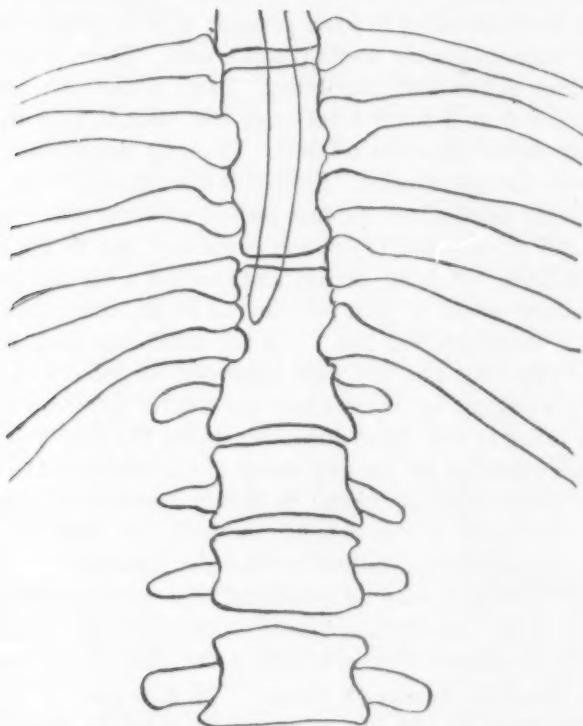


FIG. 13.—Case XIII.—A-P view of lesions shown in two foregoing figures.

included only a very limited area of spine. This procedure may well be open to criticism in view of the present findings, but was practiced for reasons of economic necessity, and because of circumstances about to be mentioned. (3) The majority of the cases had one focus much further developed and probably much older than the other; in other words the major focus may be sufficiently developed at time of examination to be recognized and accurately located clinically. It is generally the custom to send patients with a request for an examination of a specified portion of the spine, the involved vertebra often being named, and the technician, with the same purpose in mind, to get a sharply defined plate, adheres closely to the request, and is unlikely to repeat the exposure over other areas. Hence unless the clinician has demanded an extensive examination, and with a clinically well defined

lesion he has hitherto seen no reason so to do, only a closely adjacent lesion is likely to be discovered by this method. In view of these circumstances, then, it may be that a routine search for further lesions would show a somewhat higher incidence of secondary foci than any of these figures.

From the pathological point of view speculation naturally arises as to the mode of spread of this process. Are the lesions separate hæmatogenous infections from a common distant source such as the alimentary tract; or is the second the result of organisms thrown into the blood stream by the first; or is the new focus a direct metastasis by spread of the bacillus via lymphatic or connective tissue avoiding in some peculiar way the immediately adjacent segment? No definite answer seems possible now. There is certain evidence, however, in favor of the third possibility. In all of the cases found the lesser lesion has occurred at a lower level than the greater, that is, presumably, the subsequent focus below the original. In many the shadow of an abscess was seen around the upper lesion. From this it is possible to imagine a pocket of pus (the "ichor pocket" of the text books) working down next the vertebral bodies, and to conceive of erosion occurring, not in the early stage of formation, but later, when the pocket had reached a slightly lower level and where the pressure would be greatest, such as at an indentation made by the protrusion of a intervertebral disc. In the third case described at the beginning of the paper the two foci were separated by about five normal vertebrae, but in this patient an abscess had apparently formed very rapidly (his symptoms all being of very short duration), filling the iliac fossa, so that this route of spread extended all the way down to the new focus in the fifth lumbar. Such a conception of spread is purely theoretical, but if sufficient attention can be drawn to this general problem, post-mortem evidence may accumulate to explain and substantiate this phenomenon.

From these findings it may be concluded that very careful clinical examinations and a close coöperation between clinician and röntgenologist are indicated in the treatment of tuberculosis of the spine, to rule out the presence of the not uncommon secondary focus. The case cited in which this condition was recognized by the X-ray man and not till six months later by the surgeon has had a well appreciated moral in this clinic. Also that, as the second lesion seems to develop closely subjacent to the first and usually when an abscess shadow is present at the first, attention should in particular be directed toward the spine below an established lesion, and especially in those cases with abscess formation.

In summary it may be said that in tuberculosis of the spine secondary foci, separate but characteristic, are more common than generally supposed, and that a routine search should always be made for such.

NOTE.—The writer wishes to express his obligation to Dr. R. B. Osgood for many valuable suggestions in the preparation of this article.



## POSTURE AND THE CERVICAL RIB SYNDROME

By T. WINGATE TODD, F.R.C.S. (Eng.)

OF CLEVELAND, OHIO

PROFESSOR OF ANATOMY IN THE WESTERN RESERVE UNIVERSITY

IN 1911-1913 I was engaged in an investigation of the brachial plexus and the skeleton of the shoulder and the thoracic inlet with special reference to the cervical rib syndrome. In this investigation several papers were published dealing with the anatomical features concerned and with the clinical condition itself especially as regards the vascular condition (see bibliography in 9). Certain features of this work have been taken up by others and amplified. In particular it served as the starting point for the very careful researches of Stopford upon nerve injuries in the war (*e. g.*, 6, 7). The relationship of vascular conditions noted in Stopford's cases to nerve injury rests, as did the similar condition found in my own cases of the cervical rib syndrome, simply upon clinical evidence together with the inferences drawn from the detailed innervation of the nerves of the limbs shown in this laboratory by Kramer<sup>2</sup> and Potts<sup>4</sup>. This is of course insufficient evidence and it was intended to continue the investigation further so that this and other dubious points might receive some elucidation. The claim that degeneration of nerves causes alteration of vessels in the same area has been many times discussed, always with inconclusive results (*e. g.*, Spiller, W. G., 5). Recently Horrax has reviewed the work of the war years upon peripheral nerve injuries<sup>1</sup> and refers to the decortication of arteries as practiced by Leriche. No further review is necessary here but it must be remarked that removal of the fibrous arterial sheath with its contained sympathetic nerves, as carried out by Leriche<sup>3</sup> for a distance of ten centimeters or even more, cannot be done without considerable local disturbance. It is not therefore beyond all question that consequences in the limb are attributable to the sympathetic interference and that alone.

Accordingly the outbreak of war found R. G. Pearce and myself engaged upon the destruction of the sympathetic nerves to the forelimb of the dog, a comparatively easy operation without great inconvenience to the animal. Owing to circumstances beyond our control we were unable to finish this work and our results, so far as they went, were negative. It is not intended here to discuss this particular phase of the problem which will be left for the present with the statement that our work is still incomplete. Another line of investigation has however now brought some definite results and it is to this that I desire to draw immediate attention.

It is well known that posture has a definite relation to the cervical rib syndrome. The symptoms occur in the pregnant or recently delivered woman. The position of the shoulder relative to the thoracic inlet has an important bearing upon the subject and the symptoms may equally well occur in the absence of cervical ribs. Altering the posture may bring immediate relief by reducing or removing pressure. It is this relation to posture and the

curious fact that the thumb or even more frequently the index finger first shows indications of the syndrome which determined me to attempt to produce the symptoms posturally so that I might observe the form of onset and possibly the reason for earlier affection of the radial side of the hand. Accordingly in 1913 I formed the habit of sleeping with the right arm stretched out almost vertically under the head. This was uncomfortable for a time but the habit was soon acquired and rapidly became perfectly restful. I had supposed that within a short time some result might be attained but this turned out not to be the case. The posture having become comfortable it was continued with some interruption until March, 1921.

In January, 1921, tingling was noticed in the right index finger and thumb and slight indefinite loss of sensation. There occurred previously a little aching in the course of the nerves along the pre-axial and post-axial borders of the limb both above and below the elbow. It was not possible to determine which nerves exactly were the seat of this aching. The aching is still present at the time of writing (April 9, 1921), but is now confined to the post-axial border immediately above the elbow. Pressure on the aching area causes immediate tingling in the sensory distribution of the ulnar nerve. Similar pressure on the normal left arm evokes no response.

The tingling referred to in the previous paragraph was almost at once aggravated by immersing the hand in hot water. It was a dull irritating sensation, not exactly a pain but comparable with that sensation left after firm pressure on the gum close to the necks of the teeth. One would almost automatically rub the finger; this in no way relieved the sensation but rather aggravated it. Cold did not have an aggravating influence as heat did. This abnormal sensation is still present (April 9th) and affects the entire ball of the thumb but no other part of this digit, the whole of the sides and palmar surface of the index finger, and sometimes the radial border of the middle finger. It does not remain at uniform intensity but varies very greatly and may be absent altogether.

The index finger and thumb became swollen in February, 1921. Along with the swelling there appeared some paronychia, irregular desquamation of the epidermis and unusual separation of the nail from its bed. The last mentioned feature gave the impression that the nails were growing rapidly. Measurement of the weekly growth compared with that of the sound side showed this to be an error. The swelling and paronychia continued until March 30th, when the posture was altered, after which some improvement occurred. Fig. 1 shows the condition of the index finger compared with that of the sound side on March 29th just before the experiment was stopped. Defective nutrition of the nail is apparent in the horizontal wrinkling. The raising of the nail from the finger in consequence of the swelling accounts for the difference in shape of the two nails and the apparent increased growth of the right nail. Irregular desquamation on the same date is well shown in Fig. 2. At first sight it might be thought that the appearance of the right index finger was the result of formalin irritation. My skin has never been



Fig. 1.—Right and left index fingers on March 29, 1921. Note paronychia and defective desquamation on light. The nutrition of the nail is deficient. The difference between the two nails is accentuated by the raising of the right nail from its bed in consequence of the swelling of the finger: there is no increased growth.



Fig. 2.—Same fingers, same date. Note irregular desquamation of epidermis on right.



Fig. 3.—Same fingers April 9th. Note the swelling of the right finger around the nail. This type of swelling with a smooth shiny skin first appeared on April 8th. It has disappeared again by April 12th.



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subject to formalin irritation and the hands had not been in formalin for several weeks previous to the appearance of the condition noted.

In association with the paronychia, sensation became increasingly blunt and at first I attributed this to thickening of the epidermis and swelling of the finger. In particular there was great difficulty in finding the keys of a typewriter with this finger which became useless for the purpose. Slight change also occurred in the hand-writing; this may be auto-suggestion. The finger still stumbles (April 9th) on the typewriter in spite of the absence of swelling.

On March 30th, the photographs for Figs. 1 and 2 having been taken, it was considered wise to terminate the experiment by altering the sleeping posture, since the condition of the fingers had begun to interfere with routine duties. The initial symptoms of the cervical rib syndrome had made their appearance and had been duly noted and it seemed unwise to await further symptoms. There had been no cyanosis or any undue heat or redness of the affected parts. Further, if vascular symptoms were to appear later one could not rule out the paronychia as at least a contributory cause and the experiment would be just as inconclusive as previous experiments upon animals. It was, however, April 5th, before duties permitted a full examination of the affected fingers. On that day after suitable precautions had been taken to secure complete quiet and freedom from interruption, the fingers were carefully investigated by a colleague as regards sensation. There was no wasting or apparent muscular disability. The following is the result of this examination.

*Tactile sensation.*—A small piece of absorbent cotton was used.

*Dorsal surface.*—A small area of insensitiveness at tip of thumb and distal part of second phalanx index finger near the nail bed. Tingling sensation all over distal phalanx and around nail.

*Palmar surface.*—Insensitiveness on ulnar margin and adjacent area of ball of thumb, also on ball of index finger. Distinct tingling over distal part of second phalanx. No area of tingling on thumb.

*Compass test.*—Nowhere on either thumb or index finger was it more difficult to distinguish the separate points of the dividers used than on the normal side. On the radial side of the palmar aspect of the second phalanx of the index finger and on the ulnar side of the palmar aspect of the distal phalanx of the thumb the divider points could be separately felt three millimeters apart. Elsewhere on these digits it was necessary to have the divider points five millimeters apart in order to obtain the double sensation. The same results were obtained upon the normal side.

*Pain.*—Elicited with a fine needle in a needle holder.

*Dorsal surface.*—Tingling sensation over ulnar side distal phalanx of thumb and radial side of third phalanx index finger. No loss of sensation.

*Palmar surface.*—Tingling sensation entire surface second and third phalanges. No loss of sensation. The tingling elicited by stimulation with the needle was exactly the same as that evoked by the absorbent cotton. There was some delay in sensation in occasional spots on



the palmar aspect of both affected phalanges of the index. This may have been due to failure of the needle to penetrate the skin properly. Delay was more frequent and more definite in testing temperature. It was not apparent to light touch or the compass test.

*Heat.*—Water just boiled was used in a small phial. This necessitated very frequent renewal.

*Dorsal surface.*—Tingling sensation over entire surface of distal phalanges only of thumb and index finger. Some delay in irregularly placed spots in both locations.

*Palmar surface.*—Tingling along ulnar margin and adjacent area distal phalanx thumb; and along radial border and adjacent area second and third phalanges index finger. There was in addition tingling in distal part of first phalanx of index only. Some delay everywhere.

*Cold.*—The test was elicited with ice.

No alteration of sensation. Some delay in radial border third phalanx index finger front and back, and on dorsal aspect ulnar border thumb.

Comparison of this record with the distribution of the median nerve as reinvestigated by Stopford\* shows that only some of the fibers are involved.

On April 8th subjective tingling with increased heat in the affected fingers and waves of heat sensation in the arm generally set in. The index finger especially began to swell and the skin to become shiny. This condition lasted through the night but began to diminish next morning. Fig. 3 was therefore made to show the appearance before it should entirely disappear. This was the first indication of any vascular disturbance.

During the month of April occasional attacks of causalgia of even briefer duration occurred. The fingers were in a very sensitive state. Any local irritation, such as the application of formalin or photographic solutions, clapping of the hands or mechanical work in the laboratory shop, would light up a fresh attack. Holding the arm in the old posture for an hour or so would bring about the same result.

At this date (May 5th) the fingers are almost normal once more. There is no loss of sensation and the typewriter can be used as before the symptoms appeared. Apart from a slight hypersensitiveness to heat and irregular desquamation with dryness of the skin there is no disability.

May 16th, the fingers are now healed and sensation is everywhere normal.

The subject of the experiment is thirty-six years old and his history sheet is clean except for infantile disorders and otitis media. He is well built, healthy and weighs 180 pounds. There has never been any tendency to circulatory disturbance or local cyanosis, and the reaction to cold is normal. There is every reason to believe that the prolonged retention of the peculiar sleeping posture, intermittent though it was, has *some* causal relation to the symptoms described. The experiment failed to bring forward any evidence relating to vascular changes and though it emphasized the commencement of the symptoms in the index finger and thumb it suggests no reason for this distribution. That the symptoms rapidly clear on change of posture con-

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firms the established method of treating such cases in clinical practice. But the real reason for recording the experiment is the emphasis which it places upon the relation of posture to this symptom-complex with the obvious corollary that appropriate questioning may elicit the fact in certain cases that some apparently simple and harmless habit is really in part the cause of the symptoms which will disappear if that habit be broken.

### SUMMARY

It is possible to produce the cervical rib syndrome experimentally by posture alone. Since this is the case it may be the explanation of some instances at least of the disease occurring in the absence of anomalies at the cervico-thoracic junction.

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## THE INTRA-ABDOMINAL OPERATION FOR FEMORAL HERNIA

By G. PAUL LAROCHE, M.D.

OF RICHMOND, VIRGINIA

COMPLETE cure of abdominal hernia entails complete removal of the entire sac and as much as feasible of the adjacent redundant peritoneum above the hernial neck and orifice. No hernia is completely cured unless completely removed. The best incision for sac removal gives safe and most direct access to the neck and surrounding peritoneum through which may be accomplished enucleation and complete removal of the sac with least trauma to the structures involved.

In *Surgery, Gynecology and Obstetrics*, November, 1919, I described an intra-abdominal method of approach to, and removal of the sac and adjacent redundant peritoneum for the cure of inguinal and femoral hernia. By this method these purposes are completely accomplished with maximum safety from injury to the vas deferens, the urinary bladder and large blood-vessels. Adherent and diseased omentum and bowel may be adequately and safely separated from the sac and adjacent peritoneum; other organs and structures in the pelvic portion of the abdomen may be properly explored and treated through the same incision; the cremaster, internal oblique and other overlying muscles and fascia may with minimum trauma be separated from the sac and preserved for utilization in wound closure; during the final stage of enucleation, the sac and adjacent peritoneum are pulled upward away from the hernial orifice and canal and away from the bladder and large blood-vessels; and finally after excision of the sac and redundant adjacent peritoneum about its neck, the peritoneum may be sutured to structures well above and away from the previous hernial orifice. This latter consideration has obvious advantages over the method of making traction from below through which there is some liability, during ligation or suture, even by experienced surgeons, of unintentional anchorage of the peritoneum to fascia or muscle in the region of the hernial orifice or canal, to be followed by prompt return of the hernia or at least bulging at the site of the orifice.

There are some additional advantages of this method of approach incident to the location of the skin incision above the zone of infection within the hairline and from the fact that with the finger, a piece of gauze or blunt instrument within the sac, the line of cleavage between the sac and overlying muscle and fascia is more easily identified and enucleation more quickly accomplished with the least mutilation of overlying muscle and fascia.

Finally, with the field of operation entirely open, the surgeon may, after close inspection, choose the most suitable method of wound closure (canal obliteration), and whatever plastic procedures may seem useful in the individual case.

Many surgeons of large experience and good judgment have expressed



FIG. 1.—A large-sized femoral hernia.

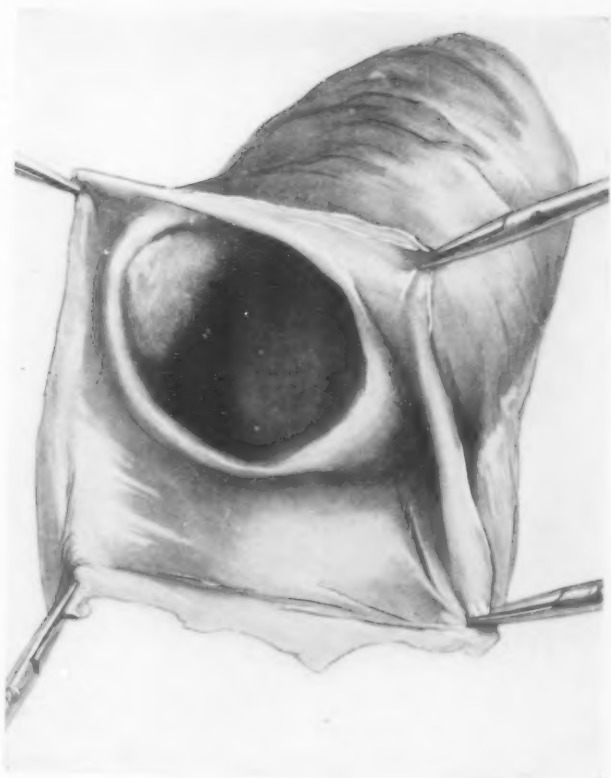


FIG. 2.—The sac of the femoral hernia with one to two inches of surrounding peritoneum after removal.



FIG. 3.—The sac and adjacent peritoneum has been removed, the cut edges of the peritoneum sutured and about to be tacked to the parietal peritoneum at the position of the internal inguinal ring and anterior abdominal wall. The femoral orifice and canal in this case easily admitting two fingers side by side, was not closed.

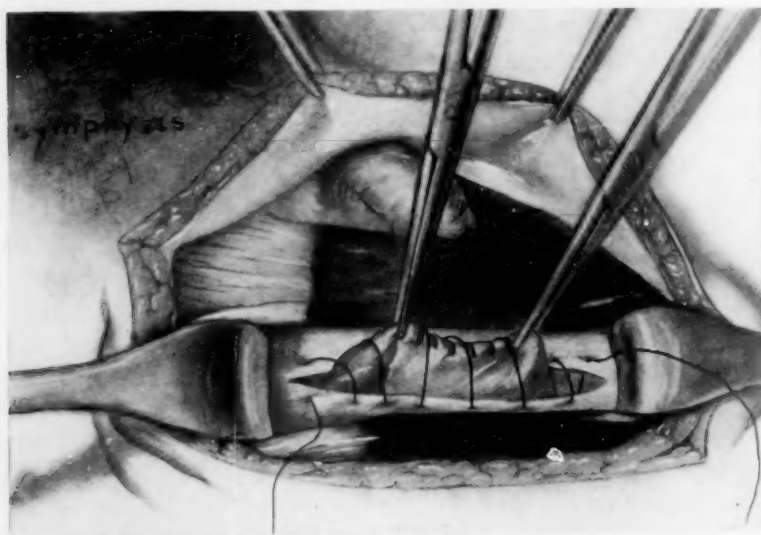


FIG. 4.—The sutured peritoneum from the region around the previous location of the neck of the hernia is now being sutured to the original incision of the peritoneum just above the inguinal ring. This suture passes through the stump of sutured peritoneum as it is held up by forceps. This does not appear to be the case in the drawing for the reason that in this particular case the sutures were passed through from the lower side.



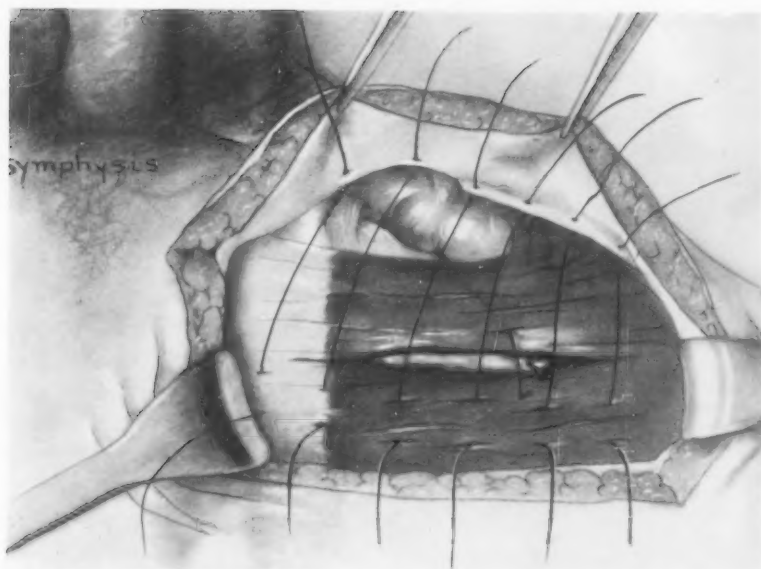


FIG. 5.—In the final closure of the split made in the internal oblique and transversalis muscles the lower end of the suture catches the under surface of Poupart's ligament. These sutures are very loosely tied and under no circumstances should they exert tension on the muscle fibres. To avoid atrophy of the little bundle of fibres on the lower side of the split, these are not caught in the suture.



## INTRA-ABDOMINAL OPERATION FOR FEMORAL HERNIA

their approval of this method of approach to the sac in dealing with herniæ of large size with contents adherent and in other ways complicated and difficult to cure, and for operating on recurrent cases (cases in which at the first operation the sac had been incompletely removed). With their stamp of approval of the usefulness of the method for large, difficult and complicated cases, I am encouraged in the belief that the method is best suited for all cases. No one has suggested that the intra-abdominal approach is difficult or dangerous. From an experience of operating upon more than three hundred cases of all types of inguinal and femoral hernia by this method, I can testify that the sac and adjacent peritoneum is more easily and completely removed from within than from without; and after painstaking effort I am unable to find a single patient who subsequently developed hernia.

After complete removal of the sac and redundant peritoneum above its neck and the highest practicable suture of the cut edges of peritoneum, problems of "orifice closure" and "canal obliteration" are problems of wound closure. This should be accomplished by the method which permits restoration nearest to anatomic and physiologic normalcy of the muscles and fascia stretched by the protruding hernia and cut and separated by the operative procedure.

The method of Halsted, as described by his pupil, Taylor (*Archives of Surgery*, September, 1920), is a perfect application of the principles of biology to the form and function of the muscles involved in inguinal hernia and solves the problems referable to the repair of the abdominal wall in relation to the inguinal canal. Indeed certain other methods of "canal obliteration" are quite adequate for this accomplishment, and, provided the sac and adjacent peritoneum are completely removed and the wound heals without suppuration or tissue strangulation and atrophy, are followed by cure of hernia without subsequent bulging.

After removing femoral hernia there are many methods of orifice closure and canal obliteration, probably none of which are necessary (Ochsner), if all the sac and adjacent redundant peritoneum about its neck is removed.

In curing umbilical hernia there is no canal to be closed. The operation consists solely of removing the hernia with its orifice and closing the wound.

The pictures here reproduced are the finished product of sketches made at the time of operation upon the case of femoral hernia herewith illustrated.

The incision is made through the skin, superficial fascia and aponeurosis just above the location of the internal inguinal ring. The fibres of the internal oblique and transversalis muscles and fascia are separated in the usual muscle-splitting fashion, making a good exposure of the peritoneum; this is then picked up and opened in the usual way. After retracting the edges of the wound, the neck of the hernia is adequately exposed from within the general peritoneal cavity. Adherent omentum and bowel can be completely and easily removed and a thorough exploration of this region of the abdomen is easily made.

With the finger or a pair of blunt curved forceps in the hernial sac from above, enucleation aided externally by a gauze-covered finger or sharp dissection is easily accomplished and the femoral and other large vessels are quite safe from injury. The sac being freed is easily turned inside out into the peritoneal cavity. The sac and redundant peritoneum in the region are pulled well upward, clamped sufficiently high to take up all the redundant peritoneum and excised. In this way the entire sac and from one to two inches of the surrounding proximal peritoneum are removed. The cut edges of the peritoneum are then sutured. It has seemed advantageous to tack the sutured portion to the position of the internal inguinal ring and to the edges of the original incision in the peritoneum. This effects practically a transplantation of the peritoneum away from the region of the femoral orifice and brings the raw surface of sutured peritoneum out of contact with bowel and omentum. The split muscles are then loosely sutured and in a hernia of small size this is perhaps all that is necessary. I have, however, made it a plan in herniæ of large size to catch the under surface of the aponeurosis with sutures placed very loosely in the manner as if closing the inguinal canal. Great care should be exercised in tying them merely to hold structures without tension.

I have never made any effort to close either the femoral canal or the femoral orifice. In the patient here illustrated the femoral canal would admit two fingers side by side. We could feel nothing resembling Gimbernat's ligament. The patient here illustrated was operated upon in October, 1920, and recently has been thoroughly examined. There is no evidence of hernia. I have operated in this manner upon twelve cases of femoral hernia. All are cured, the first case over five years, the last case counted in this report, more than six months.

TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY

*Stated Meeting Held October 12, 1921*

The President, JOHN A. HARTWELL, in the Chair

CRANIOPLASTY FOR LARGE TEMPORAL DEFECT

DR. DEWITT STETTEN presented a boy fifteen years of age, who four years ago, as a result of an automobile accident, sustained a severe depressed fracture of the skull in the right temporal region. A decompression trephining was performed at the time and apparently a considerable portion of skull was removed at the site of injury. The patient was left with a very large pulsating hernia of the brain, which after some time cicatrized and epithelialized. This protrusion gradually increased so that when the patient came under observation in February, 1921, it was the size of a large fist and covered by a broad, flat, glossy and thin scar, entirely denuded of hair. A photo of the boy taken in March, 1919 (Fig. 1), gives some idea of the protrusion. The herniation, when the patient was first seen, was about half again as large as is shown in the picture.

Mentally, the boy was a trifle subnormal. He had no headaches or convulsions. There was a paralysis of the right frontalis muscle. The X-ray examination of the skull shows a bony defect involving almost the entire squamous portion of the temporal bone (Fig. 2). The defect is irregularly circular in shape, with an average diameter of about 5 cm. The edges seem quite smooth and regular.

The chief complaint was that the protrusion interfered with the normal life of the patient. Its unsightliness was a constant source of embarrassment, and the fear of injury kept him from the usual activities of a boy of his age. It almost appeared as if the slight impairment in his psychical development was due more to these factors than to any organic cerebral injury or defect.

After a consultation with Dr. Joseph E. J. King, operative interference was decided upon.

On March 11, 1921, a preliminary scalp plastic was performed. The scar was excised by an elliptical incision. Hemorrhage was controlled easily by self-retaining retractors. A large cyst, filled with clear fluid, which represented a considerable part of the hernia, was opened. Its external wall was excised and the inner wall was cauterized with carbolic acid and alcohol. The edges of the cyst wall were sutured together. The scalp on either side was freed widely from the pericranium until the edges of the wound could be nicely approximated without tension, and the wound was closed. The wound healed



satisfactorily, leaving an almost linear scar and the protrusion was now insignificant.

On April 7, 1921, the actual cranioplasty was undertaken. It was planned to use a free pericranial-cranial transplant utilizing the outer table of another part of the skull. This method was originally proposed by Schmieden and has been used with much success by King, Frazier and Coleman. Doctor King was good enough to assist at the operation and gave invaluable help and advice. Ether anæsthesia was used. The head was so draped by fixing the towels to the skin with a crown of towel clamps that both sides of the head could be brought into the aseptic field. The defect was then prepared. The scar was excised. The pericranium was incised 0.5 cm. beyond the edges of the bony defect and the margins exposed. The dura was freed with a blunt separator. The hernia was reduced and oozing controlled by bridge sutures. The margins of the defect were freshened and all irregularities removed by beveling with an osteotome at a 45-degree angle. A linen pattern was cut and the outer side marked with a suture. The head was turned and through a straight incision over the left parietal eminence the pericranium was exposed and the pattern laid over it. The pericranium was incised around the pattern about 0.5 cm. beyond its edge down to the skull. The protruding edge of pericranial flap was turned over on the pattern and the bone flap of the outer table was cut to correspond to the pattern. The circumference of the flap was first cut and then the osteotome was directed from the periphery toward the centre of the transplant. The edges of the transplant were beveled at about a 45-degree angle to correspond to the margins of the defect and the thickness of the bone was approximately 0.25 cm. This cutting of the bone flap is technically the most difficult part of the operation. The bone graft was somewhat chipped and broken, but in the main was still adherent to the pericranium. The free pericranial-cranial transplant was laid in the defect with the raw bony surface down, and pericranium sutured to pericranium. Both scalp wounds were carefully sutured, the angles being drained by small tubes, which were removed after forty-eight hours. In the short time allotted for this presentation one cannot cover every point in the technic of the operation, but for further details on the subject reference may be made to a recent publication of Doctors King and Anderson ("Cranioplasty: Indications, Operation and Results," *Southern Medical Journal*, 1920, xiii, 719-733).

The patient showed some evidence of shock after the operation, but quickly recovered. He vomited a good deal and had a moderate headache, probably because of the increased intracranial tension, but after two days these symptoms subsided. The wounds healed by primary union and the graft took, leaving a flat, smooth and solid skull where the defect had been. The X-ray taken one month after operation (Fig. 3) shows the defect completely filled in with new bone, almost as dense as the rest of the skull. About two weeks after operation the patient had a rather severe headache for twenty-four hours, but since then there have been no headaches, convulsions or symptoms of any kind referable



FIG. 1.—Photograph of patient taken in March, 1919, showing cerebral hernia and scar.

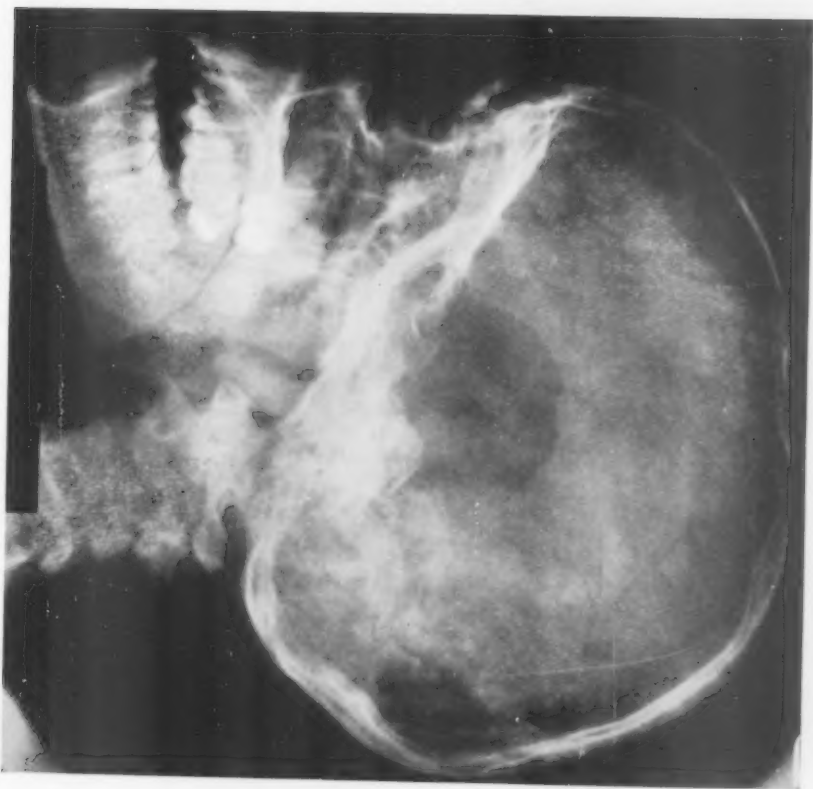


FIG. 2.—X-ray before operation, showing temporal defect.

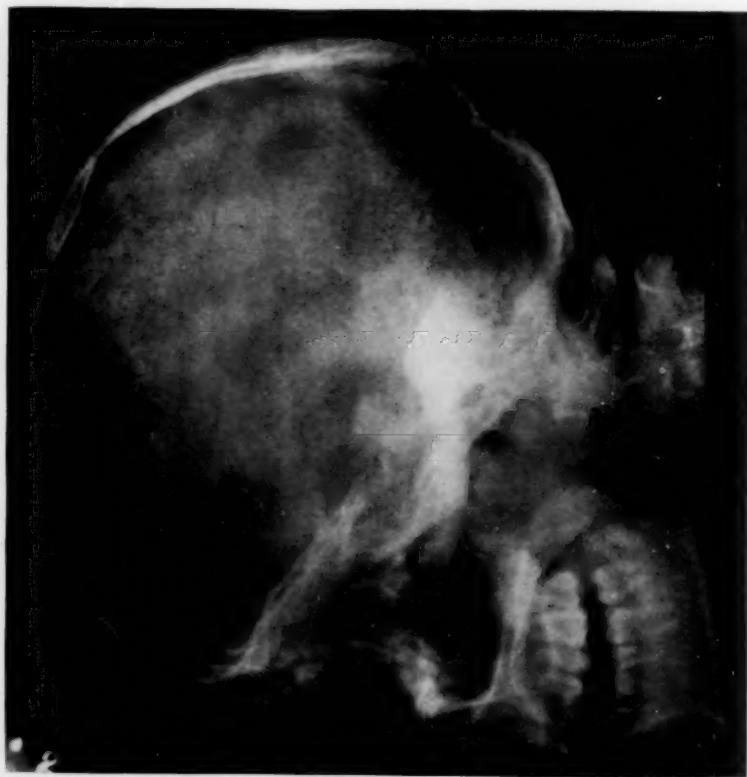


FIG. 3.—X-ray taken one month after operation, showing defect filled with new bone.



FIG. 4.—Photograph of patient taken in September, 1921, five months after operation.

## CRANIOPLASTY FOR LARGE TEMPORAL DEFECT

to the head. One can now feel a slight groove anteriorly between the skull and transplant, but the solidity of the plastic has remained and hair has covered the major part of the scar, giving the head quite a normal appearance (Fig. 4). The area from which the transplant was taken cannot be differentiated from the rest of the skull. The patient's mental condition seems improved, mainly because his unsightly and disabling deformity has been removed.

DR. J. P. HOGUET reported a case somewhat like that of Doctor Stetten. The man had been through the war, came home, and was a welder. While doing acetylene welding the tank blew up and a piece of metal struck him in the left frontal region. He was taken to a Newark hospital, where it was said the bone was so extensively comminuted that nothing could be done except to take out a few fragments. It seemed that the first nerve endings had been cut, as he had no sensation of smell or taste. He consulted Doctor Hoguet on account of persistent headaches and a feeling of insecurity and wanted something done to give him relief. Doctor Hoguet operated on him in March, 1921. He cut through the old scar, and except for the exact underlying region where the scar was slightly adherent, it peeled off easily from the dura. He freshened the edges of the cleft with rongeurs and separated the pericranium, pushing it back a little beyond the edges of the cleft. He then made a pattern of the defect on a piece of muslin. Following this pattern he removed a graft from the antero-interior aspect of the tibia, the graft being from one-eighth to one-quarter of an inch in thickness. It fitted into the cleft fairly well, leaving a little gaping. He sutured the periosteum of the graft which had been left a little wider than the graft to the pericranium around the defect. The graft soon became absolutely firm. He dressed the wound every day in order to observe the progress, and noticed that the first three or four days the graft could be moved up and down slightly. It rapidly became more and more solid until at the end of a week it appeared to be as firm as the rest of the skull. The headaches and feeling of insecurity completely disappeared.

DR. CHARLES A. ELSBERG said that he had had occasion to close quite a number of cranial defects by cranioplasty. He very rarely made a complete transplant. He usually enlarged the incision, chiseled off the outer table of the skull covered by periosteum, and either turned it around and fixed it in the defect or turned it down as a flap with the periosteum inside of the skull. This latter procedure is to be considered advisable when there is a defect in the dura, so as to prevent new-formed callus from irritating brain tissue. Doctor Elsberg stated that he also had been surprised at the remarkable rapidity with which these grafts of the outer table of the skull healed in place, so that within a few months very little abnormal could be seen in the X-ray picture.

DR. JOSEPH E. J. KING said that the first cranioplasty he saw was in 1915 when he assisted Dr. Hermann Fischer at a base hospital in Germany. That operation was performed according to the König-Müller method, that is,

by sliding an adjacent pedicle flap, consisting of the entire thickness of the scalp and portion of the outer table of the skull, over the defect, in so doing the bony portion of the flap was practically detached from the soft parts of the flap, the bony portion was placed in the defect and the flap sutured over it. In this case the bony portion took and the defect was corrected. After seeing the difficulty of removing the flap, he wondered why a complete pericranial osseous transplant would not do as well.

In 1916 he operated upon several cases and used such a transplant from the tibia. Later he visited Doctor Schmieden's clinic in Holland and found that they were using cranial grafts which were removed from the skull by an extension of the incision when possible. This type of operation was used in the neuro-surgical services at Cape May and Fox Hills by Doctor Frazier, Doctor Coleman and himself. The graft was placed with the bony side downward; they did not turn the graft upside down as Doctor Elsberg did. Doctor Bagley, at Fort McHenry, operated upon his cases and reversed the graft in the manner spoken of by Doctor Elsberg. The results reported were about the same as when the graft was not reversed. It seemed that it made but little difference in the result whether the defect was closed by the one or the other of these methods.

Doctor King said he felt that a word should be said in regard to the contra-indication to cranioplasty. A cranioplasty should not be done in the presence of sepsis. One should wait at least three months after absolute healing had taken place, and in some instances this is not sufficient length of time. In some cases one should wait six months or a year. In those cases in which a foreign body was retained, the defect should not be closed until the foreign body had been removed. Those cases, in which the brain had been penetrated and a tract had been left, should not be closed. The ideal case for cranioplasty was the deep fracture where there was no laceration of the brain tissue and where the patient was practically symptomless, with the exception that he had a hole in his head. Both Doctor Elsberg and Doctor Hoguet had spoken of the rapidity with which the graft healed in the defect. These grafts really seem to cement themselves into the defect and form a solid closure. Doctor King said they had had about eighty-four such cases and he had seen but one instance in which the graft was absorbed. In that case the patient had post-operative pneumonia followed by a right-sided empyema, due to the hæmolytic streptococcus. The graft had become absorbed after about four months, leaving the defect exactly as it was before the operation was done. A second cranioplasty was performed by this time under local anæsthesia. This graft healed in, and remained as long as the patient was observed in the hospital, a period of about three months.

Doctor King expressed the opinion that it was preferable to use a transplant from the head. It was more convenient and there was but one incision necessary in a number of cases. In cases where there is a frontal defect it will be necessary to make two incisions, a second one over the parietal eminence for the removal of the graft. In such a case it would not be advisable



## INOPERABLE CARCINOMA OF BREAST

to extend the incision over the posterior part of the skull. If the defect was a long narrow one it was better to use a tibial graft. So far as the results were concerned he had noticed no difference between the cranial and tibial grafts.

### INOPERABLE CARCINOMA OF BREAST. UNUSUAL RECENT RESULT FOLLOWING X-RAY RADIATION

DR. BURTON J. LEE presented a woman thirty-one years of age, who first was admitted to the Memorial Hospital on March 7, 1921, with a very unusual type of breast carcinoma. She had had one child, seven years of age. In November, 1918, an ulcer appeared on her upper lip, which remained unhealed for four months. A positive Wassermann was obtained. The patient was treated with hypodermic injections of mercury for a period of one year. Shortly after the beginning of treatment she began to show scaly areas upon the hands and pigmented spots over the surface of the body, which were presumably luetic. All of these symptoms subsided completely under treatment. In June, 1920, she noticed a tender swelling of the right breast, situated in its upper, inner portion. This proved to be an abscess, which was incised and soon healed.

In August, 1920, a reddish, raised area appeared over the upper, inner portion of the right breast. This gradually spread until it involved the skin over the major portion of the right breast, running somewhat over to the left. Posteriorly it had extended well around to her axilla. Her chief complaints upon admission were pain in the right breast, the presence of a mass in her right axilla and a general feeling of malaise. She seemed fairly well nourished and was of sallow complexion. Both breasts were very full and heavy and quite indurated. Both were movable on the deeper parts. The skin over the right breast was a brilliant red and contained numerous small elevated areas that looked almost vesiculated. This reddened area extended well up toward the right clavicle; over as far as to the nipple line of the left breast and to the right as far as the midaxillary line. Inferiorly it reached the rib margin.

In some places the line of demarcation between this reddened area and normal skin was quite distinct. In others it merged gradually into normal skin. The measurement horizontally of this whole reddened area was 52 cm.—vertically 38 cm. In both axillæ there were large, hard, movable nodes. In the right side of the neck there was also a chain of nodes extending two-thirds of the distance from the clavicle to the mastoid. The left supraclavicular region showed no involvement of nodes. There was a scar of the lesion mentioned, in the past history, over the upper lip.

The patient was treated entirely by X-ray radiation by Doctor Herrendeen, the radiologist of the Memorial Hospital, the first treatment being given on March 7, 1921, with a six-minute time exposure; a current of 5 milliamperes; a filtration of 4 millimetres of aluminum; using a 9-inch spark gap and a 10-inch focal distance. Treatment given over the right breast anteriorly and laterally.

At two-day intervals the supraclavicular and axillary regions were similarly treated.

Beginning April 6, 1921, a second cycle was given, being confined entirely to the involved skin area. Time exposure was four and a half minutes; with a current of 7 milliamperes; a filtration of 3 millimetres of aluminum; using an 8-inch spark gap and an 8-inch focal distance.

Four additional treatments have been administered—one on June 24, 1921—time exposure being 12 minutes; current of 4 milliamperes; filtration—3 mm. of aluminum; 10-inch spark gap; and 12-inch focal distance. Three other similar treatments were also given on July 15th, August 8th and September 6, 1921, save that the time exposure was for fifteen minutes.

A section removed from the reddened area over the upper mesial portion of the lesion was pronounced by Doctor Ewing to be "mammary cancer invading the lymphatics of the derma." Nothing in the pathological examination suggested a syphilitic element in the lesion.

Doctor Ewing's pathological report on the case was as follows: "Sections of the skin and subcutaneous tissue reveal a cellular carcinoma invading the lymphatics just beneath the epidermis, about the hair and sebaceous follicles, and about the blood-vessels of derma and subcutaneous tissue. These lymphatics are everywhere filled and often distended with masses of large polyhedral cells with hyperchromatic nuclei. They resemble the cells of mammary duct carcinoma. About the lymphatics there are many lymphocytes, some of which are also found lying among the tumor cells. There is considerable congestion of small blood-vessels and much œdema, but no definite hemorrhages can be seen. The epidermis is thin and scaly but otherwise unaltered. The endothelial cells of the invaded lymphatics appear unchanged."

A radiograph of the chest made by Doctor Herrenden on March 7, 1921, showed no definite evidence of carcinoma. A second plate made June 6, 1921, revealed evidence suggesting carcinomatous metastases. No further plate has been made to date.

A Wassermann reaction—April 4, 1921,—gave a two plus result.

The last note made upon the patient was on September 12, 1921, Whereas her weight upon admission was 134½ pounds, it was 158½ pounds on this date. There was a marked disappearance of the superficial lesions, but there were still three small superficial masses attached to the upper, lower and outer portions of the right breast. The right breast itself seemed heavy, but no distinct tumor could be made out of it. The left breast also seemed firmer than normal.

In the right axilla there was a mass of nodes, and there was a similar mass in the left axilla.

The patient was shown as a very unusual type of primary inoperable mammary carcinoma and to illustrate also the marked regression possible in a superficial lesion treated by proper X-ray radiation.

Doctor Lee believed that the patient would finally probably succumb to her disease, but felt that the treatment by X-ray radiation had certainly given a very interesting palliative result to date and had undoubtedly helped to prolong the life of the patient.



FIG. 5.—Dr. Lee's case of carcinoma of breast, original appearance before treatment, March 7, 1921.



FIG. 6.—Results in four months after beginning of treatment.



FIG. 7.—Results six months after beginning of treatment.

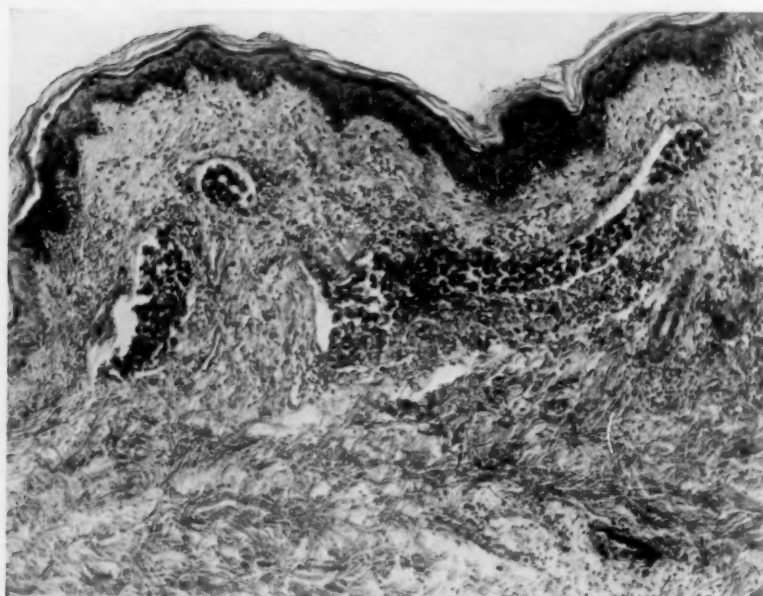


FIG. 8.—Microphotograph from Dr. Lee's case of inoperable carcinoma of the breast.

## BRANCHIAL FISTULA

DOCTOR LEE said that the patient represented a rather unusual type of carcinoma. They had, however, seen four or five cases of the pseudo-inflammatory type of breast cancer, but here there was a diffuse redness and a blush over the large area of skin involved. He had never seen quite this picture. So far as the type of carcinoma was concerned, it certainly was not an adenocarcinoma. The disease was rapidly infiltrating, was very cellular and had spread rapidly into all areas. So far as removing a section from the breast itself was concerned, the patient had been unwilling to allow incision into the gland. He believed she would soon consent to the removal of one of the axillary nodes which would probably furnish additional pathological data. She had received no anti-leucic treatment since her admission to the clinic, though she had been treated before the appearance of the breast lesion.

Doctor Lee stated that they had seen a number of cases of carcinoma that responded readily to X-ray treatment, but most of them soon showed a reappearance of the lesion, and the process went on at the same rate as before treatment or sometimes more rapidly. He would be glad to report on this case later. He thought it was proper to criticize the diagnosis of breast carcinoma without a section from the breast itself, though he believed there was little doubt that that was what the patient had.

## BRANCHIAL FISTULA

DR. HOWARD LILIENTHAL presented a man twenty-six years old, who entered Mount Sinai Hospital May 5, 1920. His tonsils were said to have been removed in June, 1919, but tonsillar tissue was still present. The patient had a congenital discharging sinus over the lower part of the anterior portion of the sternomastoid muscle. The discharge was sometimes mucoid and again purulent. A fine probe passed upward through this tiny orifice for four or five inches and the probing excited reflex cough. There were palpable lymphnodes on both sides of the neck and in the axillæ and inguinal regions.

On May 6, 1920, Doctor Lilienthal operated, general anæsthesia preceding the operation by an injection of concentrated solution of methylene blue into the sinus. None of the dye appeared in the patient's mouth. He incised the skin around the little orifice so as to mobilize the fistula. Traction upon the mobilized part made it possible to palpate through the skin a cordlike mass running upward and slightly backward. The incision was carried from the fistula upward and backward to the angle of the jaw and the fistulous structure was easily followed to this point where it appeared to widen and to proceed toward the pharynx. It was covered throughout with longitudinal muscle fibres which contracted actively on deglutition, drawing the entire mobilized cyst upward with a cremaster-like action. This muscle was now dissected off and methylene blue was injected into the higher part of the canal with a hypodermic syringe. The dye appeared immediately in the mouth behind the right tonsil. Through an incision in the wall of



the tract he easily passed a filiform bougie into the patient's mouth and tying a piece of strong silk to the buccal end of the bougie he drew it out through the wound in the neck, leaving a long piece protruding through the mouth. The external end of the silk was then tied firmly around the wall of the sinus at the fistula and drawing upon the end which protruded from the mouth he was able to invert the entire tract and to cut it off, leaving a very short stump close to the mouth. The external wound was closed with drainage by means of a small-calibre tube which reached from below to the pharyngeal wall.

Healing was rapid and when the patient was seen on June 25th was complete. Strong pressure behind the angle of the jaw would cause the appearance of a minute opaque bead in the mouth. The patient is now entirely well. There is no discharge anywhere, but in the mouth behind the right tonsil, a minute papilla marks the location of the oral aperture of the sinus.

DR. FRANK S. MATHEWS stated that there are described a number of dissections of fistulas of the second branchial cleft which have shown that the fistula passes between the external carotid artery in contact with the internal jugular vein and pneumogastric nerve before entering the wall of the pharynx. The close relations of these important structures add greatly to the difficulties of dissection and show the wisdom of employing the method recommended by Doctor Lilienthal.

DR. SEWARD ERDMAN said Doctor Lilienthal had spoken of the branchial cyst in this case opening into the pharynx. He had recently seen a thyroglossal cyst which opened into the pharynx. Thyroglossal cysts were not uncommon. This one occurred in a young girl. It was egg-shaped and lay between the thyroid and the hyoid bone. It was red, tender and swollen. After pressure on the cyst the girl said she felt a discharge come into her mouth. On examination it was found that pus welled up at the base of the tongue. Doctor Erdman said this was the first time he had been able to demonstrate a patency of the thyroglossal duct, through the foramen cæcum of the tongue.

DOCTOR LILIENTHAL, in closing the discussion, said that this fistula must have gone in the direction Doctor Mathews mentioned. In dissecting he had kept pretty close to the muscle covering the structure. He did not go to the end of the tract because he thought the dissection would become more and more tedious and troublesome, so he tried to invert it into the mouth to avoid this. Thyroglossal fistulæ were much simpler so far as the actual dissection goes than branchial cysts because one is less likely to strike any important structure. Doctor Lilienthal said he had had a number of these cases, but this was the only one that had come to him first; all the others had come to him after others had treated them and after there had been infection. The branchial fistulæ were more difficult to get out than the thyroglossal because they were apt to have ramifications which made the problem of their removal more serious.

## SPLENECTOMY FOR PERNICIOUS ANÆMIA

### SPLENECTOMY FOR PERNICIOUS ANÆMIA

DR. J. M. HITZROT reported the case of a woman, aged thirty-six, who was admitted to Doctor Connor's service, New York Hospital, September 25, 1920, complaining of weakness, numbness, throbbing in head, stomach trouble. Present trouble began five months ago with feeling of weakness, belching of gas and swelling of the ankles. Her appetite became very poor. Condition has increased steadily up to her admission. Menses negative—normal. Important points on physical examination were lemon color of skin, general anæmia. Teeth gone. Heart—soft systolic murmur at apex. Lungs negative. Abdomen negative except for small umbilical hernia. Spleen was considered palpable by some members of the staff and not by others. Pelvic negative. Hæmoglobin, 30; red blood-cells, 1,000,000; white blood-cells, 1300; polymorphonuclears, 41 per cent.; lymphocytes, 47 per cent.; eosinophiles, 2 per cent. Occasional normoblast. No increase in blood platelets.

Stomach: Total acid 1.6; free HCl 0.8. Lactic acid negative. Guaiac tests negative.

Fluoroscopic (Doctor Holland): Heart, liver and œsophagus negative. Stomach orthotonic, hooked, good position. No defects or spasm. Negative for organic change.

Stool examination negative for parasites or ova.

September 28, 1920: Transfusion 350 c.c. blood; chill.

October 8, 1920: Transfusion (from another donor) 400 c.c. blood; no reaction.

October 24, 1920: 300 c.c. from first donor; same reaction.

November 5, 1920: Transferred to First Surgical Division.

November 8, 1920: Operation, splenectomy. Spleen three times normal size. Perihepatitis. Gall-bladder thick walled, containing stones, removed between clamps. Small subserous fibroid in uterus. Appendix normal; not removed.

Discharged eighteenth post-operative day; hæmoglobin 55 per cent.; red blood-cells, 3,000,000.

Culture from gall-bladder sterile.

Condition has remained stationary since then.

Blood, October 3rd: Hæmoglobin, 45 per cent.; red blood-cells, 2,500,000. Numerous normoblasts. The symptoms existing before.

DOCTOR LILIENTHAL said that he had done a number of splenectomies, although only one in a case of pernicious anæmia. That patient died of morphine poisoning after the operation.

Doctor Lilienthal asked Doctor Hitzrot what type of blood transfusion he employed. He said he asked this particularly because of the chill that so often followed transfusion by the citrate method, the reply being made that the citrate method was used.

DOCTOR LILIENTHAL expressed the opinion that in primary blood disease it was better not to use the citrate method but to use whole blood. He said he had formerly used the citrate method following pulmonary lobectomy. He formerly did a blood transfusion after lobectomy because there was a

huge outpour of bloody serum into the pleura for the next forty-eight hours following the operation. It was equivalent to the loss of a large amount of blood because the fluid contained as much as 10 per cent. hæmoglobin. That loss had to be replaced, so he had used blood soon after the operation. He had had two cases in which death occurred with a terrific rise in temperature after transfusion immediately following lobectomy. There always seemed to be more or less reaction following transfusion by the citrate method after lobectomy; so he had given up all except the direct methods. He preferred one of the syringe methods which had less danger of reaction than the citrate method. Whether the citrate method acted as well as whole blood in primary anæmia he was not enough of a hæmatologist to say, but he would like to hear what others had to say on that point.

DR. FRANZ TOREK said it would be encouraging to hear of a case of pernicious anæmia successfully treated by splenectomy. In the case reported he did not hear any mention of the presence of megalocytes or megaloblasts in the blood. To his understanding a case of anæmia could not be diagnosed as pernicious anæmia unless the blood contained megalocytes and megaloblasts. Doctor Torek reported a case of his own of pernicious anæmia in which he performed splenectomy. The patient was a Russian, twenty-seven years of age, ill for three years with the characteristic clinical symptoms of pernicious anæmia. When he came to the hospital his blood count was hæmoglobin 40 per cent., red blood-cells 1,900,000, white blood-cells 2400. Megalocytes and megaloblasts were present. The patient had all the characteristic symptoms, a sallow yellow appearance, such general symptoms as weakness, loss of appetite, loss of weight, constipation, headaches, dyspnœa, slight œdema, polyuria, blood in the urine and blood in the stools. The stools were examined and no bothriocephalus ova were present. The patient was transferred from the medical department to Doctor Torek's service. He operated on him on October 2, 1920. He had a very normal post-operative course. After about two weeks his wound was completely healed and he was retransferred to the medical service. While in the surgical division blood studies had been made practically every day, and later quite frequently until he was discharged after the medical division had studied him about a month longer. When he was discharged he felt distinctly better, though the blood examination showed no improvement whatever, either as to the degree of the anæmia, the number of red cells remaining as low as before, nor as to the kind of anæmia, for he still had megalocytes and megaloblasts. He went out and took a job which required about two hours of work daily. Doctor Torek mentioned this because before his admission to the hospital he had been unable to work for two and a half years. Three months later he returned to the hospital. His blood count was then 10 per cent. of normal. His symptoms were mostly gastric. He died about eight days after admission. The autopsy showed a hypertrophied heart, parenchymatous nephritis and the cause of death was pernicious anæmia. The appearance of improvement was probably nothing more than one of the remissions one sees in cases

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of pernicious anæmia without treatment. Sometimes remissions last quite a long time whether the patient is treated by splenectomy and transfusion or not.

Doctor Torek added that the incision he had used in doing the splenectomy was one he had devised but had never published. It began at the ensiform cartilage, ran along the left costal border and extended to the posterior axillary line or still further back. The front part of the incision passed outward and downward and the back part ascended again. This incision permitted raising the costal arch, giving good access to diaphragmatic adhesions and bands. It was a combination of the anterior costal incision and the oblique lumbar nephrectomy incision. It had one drawback in that more blood-vessels had to be secured than with the rectus incision, but this was more than counterbalanced by the greater ease with which one could handle adhesions and the greater access to the entire region. Where the spleen was movable the ordinary rectus incision was satisfactory.

DR. RICHARD LEWISOHN stated that they had had occasion to test the different methods of blood transfusion in pernicious anæmia, using citrated and uncitrated blood, and they had found that it was really not the method which played any rôle in the effectiveness of transfusion, but it was the time at which it was done. In the early stage any method would be effective, but if one got a case of pernicious anæmia in the late stage no method would be of great benefit. Doctor Lilienthal mentioned chills following citrate transfusion. There was no doubt that among the citrate cases a larger percentage had chills than among the non-citrate cases, the percentage in which chills occurred being twenty-five in the citrate cases against five in the non-citrate cases, but no method of blood transfusion was free from chills. Doctor Neuhoof, who administered 6 to 8 grams of sodium citrate intravenously for the prevention of hemorrhage, did not observe one chill among 100 cases. The real cause of the chills still remains unknown.



## CORRESPONDENCE

### FRACTURE OF THE METATARSAL BONES—BLOODLESS REDUCTION

EDITOR OF ANNALS OF SURGERY:

SIR:

IN the ANNALS OF SURGERY, August, 1921, page 214, there is an article on "Fracture of the Metatarsal Bones," with a report of four cases. These fractures were all reduced by open operation, and in only two cases, according to the histories, "an attempt was made to reduce the fractures and dislocations under ether anæsthesia without success." In conclusion the author writes: "If there be deformity sufficient to markedly destroy the convexity of the bones, especially if more than one bone is broken, or the fracture includes the second and third metatarsal bones, then open operation should be considered."

I saw in consultation recently a case quite similar to Case IV of the above series. This patient's left foot was run over by a motor car. X-ray (Fig. 1) revealed comminuted fracture of the second, third and fourth metatarsal necks, with plantar displacement and shortening of the distal fragments also, fracture-luxation at the fifth metatarso-phalangeal joint, fracture of base of first metatarsal, and of outer sesamoid. It will be noted that the second toe rides between metatarsals two and three; the third toe rides on metatarsal four, while the fourth toe rides between metatarsals four and five, the fifth toe being displaced lateral to its metatarsal head. These displacements are practically identical with those in Case IV and are what one would expect, given a vulnerating force acting from the lateral to the mesial border of the foot and compressing the arched metatarsals proximally and the flat toes distally. The following then must be the mechanism of reduction in these cases. With both thumbs applied to the plantar surface just behind the displaced metatarsal heads, the latter are shoved vigorously forward and inward, an assistant at the same time exerting traction upon the toes in the same directions. Then, while the assistant maintains his hold on the toes, the metatarsal shafts are spread by plantar manipulations aided by dorsal pressure. This mechanism is one by which the deformity is virtually "untwisted."

Accordingly, under nitrous-oxide-ether, with the assistance of Dr. S. R. Skillern, Jr., this plan was carried out, with the result shown in the skiagram (Fig. 2)—again similar to that of Case IV of the above series, but in which the open method was employed.

I therefore submit this method as the one of choice, especially in those cases—as in mine—where there are constitutional contra-indications to open operation.

Respectfully yours,

P. G. SKILLERN, JR.





FIG. 1.—Fracture of metatarsal necks before manual reduction.



FIG. 2.—Fracture of metatarsal necks after manual reduction.



## BOOK REVIEWS

EPHRAIM McDOWELL, FATHER OF OVARIOTOMY AND FOUNDER OF ABDOMINAL SURGERY. With an Appendix on JANE TODD CRAWFORD. BY AUGUST SCHACHNER, M.D. Cloth, 8vo., p. 331. Philadelphia, J. B. Lippincott Co., 1921.

Here is a book with a mission which the author has approached with all the zeal of an enthusiast and all the enthusiasm of a zealot. Fortunate is the man whose memory finds such a recorder to preserve it. Perhaps the most interesting and not the least important pages of this volume are those which present the attitude of the leaders in surgery in McDowell's time and for a generation thereafter, toward surgical attacks upon ovarian tumors. The reaction of the two Hunters to the problem is significant of all. In 1757 William wrote that he had seen a great number of encysted dropsies of the ovary and yet had never seen one cured. From his observations both in the living and the dead body he pronounced the disease to be incurable and expressed the opinion that a patient thus afflicted could have the best chance of living longest who does the least to get rid of it! His brother John, however, went a step farther in 1785 when he said that "he could not see any reason why, when the disease could be ascertained in an early stage, surgeons should not make an opening into the abdomen and extract the cyst. The merely making an opening into the abdomen is not highly dangerous." But, the more's the pity, John Hunter never did this reasonable and, in his opinion, not highly dangerous thing, notwithstanding according to the testimony of his brother the cases demanding it were to be seen in great numbers around him.

The possibilities of such operations remained an academic question until subjected to the test of an experiment made by a thoughtful, resourceful, self-reliant man in a frontier town of an American settlement!

The French School of Surgery, then the most dominant surgical influence in Europe, was even more positive in denouncing any intraperitoneal efforts than was that of Great Britain, and it was not until fifty years after the great and successful experiment of McDowell that the surgeons of Paris were willing to admit an ovariectomy to be a justifiable operation.

McDowell had undoubtedly become familiar with the academic side of the ovarian tumor question during his Edinburgh years. We can imagine his mental processes as he listened to the discussions of the subject by John Bell, and his quiet firm resolution that after he got back to his own land no case of the kind would be turned away from his door without the offer from him to make trial of the only possible means of relief. So when in December, 1809, Mrs. Crawford rode up to that door, he was ready for the experiment. But what shall be said of the woman? Her surgeon to raise her courage and hope, could not point to any record of successful attempts in similar cases either by others or by himself. He could but inform her of her dangerous situation and propose to her a procedure for her possible help which he was willing to make but which he had to confess was purely an experiment. The courage,

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fortitude and determination of the woman was equal to the test. Success crowned the effort—not only were many years added to her own life, but she had been the means of demonstrating to an incredulous world the possibility of help to a fatal condition hitherto considered incurable. She was the first of an endless procession of women in whom hopeless suffering was to be relieved and to whom countless years of active life were to be added. The fullness of time for the advent of this ray of light to womankind had indeed come. It was Mrs. Crawford's happy lot to be the blessed agent of this new boon to humanity. All things conspired to make the experiment a success. Had it been otherwise we probably should never have heard of McDowell. As it was the operator, encouraged by the successful issue of the experiment, but not unduly elated by it, proceeded in after years to repeat his work in other cases and so remove it from the domain of experiment to that of demonstrated fact. After the completion of the third case with in all an equally happy issue, he made public his experience in 1817, by a contribution to the *Eclectic Repertory*, vol. vii, page 242, of Philadelphia, and by a memoir sent to his old Edinburgh teacher John Bell. In a letter written in 1829 about one year before his death, he says that in addition to his first case he had up to that time operated eleven times, with one death. Thus it must be admitted that McDowell's work was neither accidental nor sporadic. It was a thoroughly thought out, well matured procedure without precedent, but yet not without reason. It was the first intentional, systematic invasion of the peritoneal cavity to gain access to and to remove a diseased organ. There was nothing pyrotechnical about McDowell. He was modest, unassuming, thorough, but self-reliant and positive, quick to let action wait upon conviction. He was in a high degree the special product of ancestry and environment. The coming generations cannot do him too much honor, and among womankind especially should his name be revered.

In this delightful book of Schachner's, from every possible viewpoint the career of McDowell is presented with much fullness. The author has produced more than biographies of the two great actors in this drama of the first ovariectomy. He has given us a critical study of the man and his time.

He has also greatly added to our knowledge of the other actor in this drama, Mrs. Crawford; tracing her to the date of her death at the age of 78 years, and her burial in a remote and obscure cemetery in Indiana.

True to the genuine spirit of his own State, he has not failed to magnify the peculiar position which Kentucky occupied in the early advance of the frontier of civilization beyond the Atlantic seaboard and to give a clear outline of the special influences, molding character, in which the hero of his worship grew up.

We thank Schachner for this work. It is evident that great labor and time and expense have been given to its compilation, with the result of the production of a book of the greatest historical value.

LEWIS S. PILCHER.

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THE SURGICAL EXPOSURE OF THE DEEP-SEATED BLOOD VESSELS. BY J. FIOLE, M.D., and J. DELMAS, M.D. Translated and edited by CHARLES GREENE CUMSTON, M.D., 8vo. cloth, p. 87. London, William Heineman, 1921.

This work is devoted to the description of procedures for freely exposing injured blood-vessels, in order that the pathologic conditions existing may be clearly seen and properly dealt with. These procedures have been suggested by war conditions and belong more especially to the domain of Military Surgery. The authors admit that the ligation of arteries in healthy tissues should still be carried out through the limited incisions that have become classic and are commonly described in all text-books of Operative Surgery. The case is altogether different, however, when the surgeon has to do with an injured vessel complicating a gunshot wound, when a diffuse hæmatoma or a focus of lacerated and disorganized tissue is the area in which a vessel is to be sought for; its damaged walls are to be recognized, and as much of it as possible to be saved in order not to unnecessarily compromise the vitality of the tissues which depend upon it for their vascular supply. A full and abundant exposure of the whole region involved alone can satisfy the requirements of such cases. Perfect and constant visual control over the field of operation is essential for safe and good work.

As one reads this plea for a change in methods of surgical effort in vascular surgery, one realizes that it is quite in harmony with the tendency of all surgery at the present time to abandon blind methods; to uncover every lesion by generous and free superficial incisions. The more deeply seated the condition to be dealt with, the more liberal the approach to be provided so that adequate exposure be secured for the performance of safe and certain surgery.

The recommendations of this book therefore are perfectly consistent with the best general surgery. The larger vessels of the limbs and of the neck are in succession dealt with. The illustrations are well designed. The descriptions are concise and clear. The translator has done his work well.

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MODERN ITALIAN SURGERY AND OLD UNIVERSITIES OF ITALY. By PAOLO DE VECCHI, M.D. 8vo. Cloth; pages 249, illustrated. New York, Paul B. Hoeber, 1921.

This is an attractive book which cannot fail to command the interest of every surgeon whose horizon extends beyond his own parish. The modern surgeon has been as a matter of course thoroughly acquainted with the work of the Germans and the French and the English. The author with pardonable national pride is of the opinion that Italy has been sadly neglected and her share in the world's efforts toward further advancement in every branch of study, has not been recognized if indeed it has not been almost ignored. He calls attention to the fact that the recent World War has not only been a revelation of a new Italy to many foreign nations but has been a revelation



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to herself. Italians of different provinces, heretofore unknown to each other, have been brought together to their mutual advantage and a better appreciation of the scientific value of the work done by their own countrymen. The object of the author therefore in this book is to familiarize American surgeons with the Italian School of Surgery; prompting them to visit Italy not only as a pleasure resort or a centre of antiquities but as a new seat of education.

The book opens with a rapid sketch of the creation of modern Italy, then takes up various phases of different military surgery in Italy, and then goes on more in detail to speak of the work and progress of the surgeons to be found at the present day in the various university centres of the country. The book is well worth the attention of every surgeon who desires to keep familiar with surgery's progress everywhere.

LEWIS S. PILCHER.

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